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ACETYLENE GAS.

The convention paper by Mr. Ferguson, printed in abstract in another column, on "The Commercial Value of Acetylene Gas," is quite in contrast with the paper read before the Northwestern Electrical Association on the same subject, in which was given a most glowing prospect for that illuminant as a competitor to chemistry. Mr. Ferguson's figures show how unjustifiable are the claims made by acetylene gas promoters as to the cost of production and the method of distribution of the liquid gas in cylinders to consumers. As will be seen, on a basis of cost for electrical power the same as at Niagara, the cost of a ton of carbide is $34.69 cents per ton. Adding $3 per ton for freight the equivalent cost of the gas in a receiver ready for distribution is 37.69 cents per thousand feet, whereas the cost of ordinary illuminating gas is less than 30 cents, and a figure as low as 22 cents has been attained. The absurdity of the manufacture of calcic carbide being carried on by central stations as a by-product is pointed out. Mr. Ferguson finds that the generating cost of a horse-power-hour of electrical energy at the switchboard is about $65 per year in large stations, not including distribution and general expenses, and double that amount in smaller stations using steam. The entirely unjustifiable nature of the claims of acetylene promoters were, we believe, first pointed out in the columns of this journal, and it is gratifying to find our conclusions confirmed by the careful study by Mr. Ferguson of all of the factors concerned.

THE ELECTRICAL EXPOSITION.

The idea of introducing special features of entertainment during the course of large expositions, to promote and sustain public interest, we believe is a Yankee invention. It was extensively carried out at Chicago during the World's Fair, and its advantages have been recognized and availed of at subsequent enterprises of the kind. It is not surprising, therefore, that the managers of the Electrical Exposition now in progress in this city, should adopt this useful device to stimulate public attention and interest in their worthy show. The fact that electricity furnishes the motive for this exposition, the managers have it in their power to accomplish results that could not be essayed through other instrumentality than electricity. Hence the success of last Saturday night's unique and interesting diversion, while complete, was not surprising, when it is remembered that for the time being the managers of the Exposition had at their command the electrical nerves of almost the entire world. In itself, the fact that two telegraph circuits, practically encircling the globe, started from and ended at the hall, was deeply interesting, but to fully appreciate the actual realities involved is not altogether an easy task. The messages sent by the distinguished persons went as far around the earth as the extension of telegraph lines and cables would permit, and returned to the starting point in less than an hour. The accomplishment of this remarkable feat cannot fail to impress the reflective mind with the wonderful realities and possibilities of electricity, and its success exemplifies the thorough organization of the vast telegraph systems of the world, and the harmony existing between them. Apart from its advertising features the affair was certainly of the most interesting character; it was original in its conception and successful in its results.

THE USE OF TWO-PHASE CURRENTS IN NEW YORK.

With the advent of the Electrical Exposition a prominent lighting company announces its intention of selling power, using two-phase currents and appropriate motors. It may be safely said that this attempt, while by no means new, will ultimately prove to be the

nucleus of one of the largest polyphase plants in the United States. The demand for power in New York is very great, and after conservatism has been overcome the obvious advantage of polyphase current motors will cause them to be largely used. The economy that will be realized by the day load thereby obtained will set the example to scores of other lighting companies in large cities. Polyphase transmission and polyphase machinery is like the metric system, admittedly valuable and practical, but extremely difficult of general adoption. Besides this conservative feature, many who are inclined in its favor are waiting for some one else to do the experimenting. Fortunately, both for New York and the stockholders of the lighting company in question, the latter has experts in its employ who are conversant with the system proposed, and in whom the management has complete confidence. There is no good reason why the enterprise should not be successful. New York, both in capitalists and in its municipal government, is too much inclined to let other cities set the pace, but here is an exception which is notable, and should receive deserved encouragement and success.

THE TESTING OF LUBRICANTS.

The great difference that exists between various lubricants has doubtless been impressed upon all in charge of machinery, and therefore the practical value of an apparatus for making tests of oils cannot but be fully recognized. To make such tests, however, even with the most carefully designed and constructed apparatus, and obtain concordant results is, however, far from a simple matter. The coefficient of friction thus obtained includes two factors—the coefficient of oil and of the journal and bearing surface—while, if the temperature is not fixed, a third one is introduced. In any event it is preferable, instead of accepting a coefficient derived from a test as an absolute quantity, to consider it as merely comparative and its bearing determined by reference to other tests made with the same apparatus under the same conditions. Even to obtain satisfactory comparative results, certain precautions should be observed, as follows: The journal should be hollow and ground to surface. The first requisite is necessary in order that in different tests the same temperature shall be maintained; experience has shown that the slightest irregularity of the surface of the testing ground may produce such discordant results that no precautions should be neglected on this score. The bearing surface should be preferably genuine babbitt (this with sufficient antimony to make the molten metal run freely). It is doubtful if genuine babbitt has ever been exceeded by any alloy in anti-frictional qualities, and a bearing of this material is easily kept in good condition. The utmost care should be used to scrape the bearing to fit the journal. Before every test both journal and bearing should be most thoroughly cleaned, and the journal should not be permitted to remain in place when the testing apparatus is not in use. The journal should not be rigidly coupled to the driving shaft, but driven by means of pins. The load on the journal should approximate to the actual load on the bearings with which the oil tester is to be used; it has been found that an oil which will stand an excellent test under one pressure will give very poor results under another. For roughly comparative results, a solid journal may be used and the rise in temperature of the bearing noted for equal amounts of work, the temperature readings being taken from a thermometer immersed in mercury contained in a hole bored in the bearing. In any event every set of tests should include one to determine the action of the oil at higher than the normal temperature and pressure. Every steam plant of any size should use two grades of oil—one for light pressures and another for main bearings, as the oil suitable for one of these purposes is not the best for the other. For condensing cylinders the use of any other than a pure mineral lubricant should not be permitted, while for non-condensing cylinders a mineral lubricant is preferable owing to its greater cleanliness. By mineral lubricants is not meant the 20-cent oils sometimes purchased, but a high fire-test and well-refined oil. It is poor economy to use cheap oils in a cylinder, particularly as with oil of good quality a surprisingly small amount is required. In fact, it is questionable if any lubricant at all is needed in the cylinders of vertical engines.

General Electric's Annual Meeting.

The annual meeting of the stockholders of the General Electric Company was held at the company's offices in Schenectady, N. Y., on May 12. A little more than 200,000 shares were represented in person or by proxy. The directors elected are the same as elected last year, except that George Foster Peabody takes the place of Thomas K. Cummins, Jr. The board for the ensuing year is therefore composed as follows: Oliver Ames, 2d; Jefferson Coolidge, Jr.; C. B. Coster, Thomas A. Edison, Eugene Griffin, Gordon Abbot, F. S. Hastings, Henry L. Higginson, George P. Gardner, J. Pierpont Morgan, Robert Treat Paine, 2d; George Foster Peabody, C. A. Coffin. Officers for the ensuing year are to be elected by the new board of directors. The usual annual routine business was disposed of.

New York Electrical Society.

The annual meeting of the New York Electrical Society was held at the Electrical Exposition on the evening of May 18. The following named gentlemen were elected officers for the ensuing year:

President, Dr. C. E. Emery; vice-presidents, Herbert Laws Webb, Gano S. Dunn, Max Osterberg, A. L. Riker, William Finn, W. W. Kerr; treasurer, Henry A. Sinclair; secretary, George H. Guy.

After the business of the evening was concluded the members spent the time in visiting the various exhibits and otherwise enjoying themselves.

Remarkable Feat in Telegraphy.

An interesting affair took place at the Electrical Exposition last Saturday night. The occasion was the transmission from the hall of special despatches over telegraphic circuits arranged as nearly as possible around the earth, and their receipt at the same place, after having accomplished their long journey.

The principals in this noteworthy event were men of prominence and the unique undertaking was attended with the most successful results.

The details of this remarkable feat will no doubt possess great interest to our readers.

In accordance with the prearranged programme for this special occasion, Hon. Chauncey M. Depew, Hon. Hamilton Fish, James A. Scrymser, president of the Central & South American Telegraph Company, and President A. B. Chandler, of the Postal Telegraph Cable Company, met in a box on one side of the gallery, and in a box on the opposite side were Thomas A. Edison and President E. D. Adams, of the Niagara Falls Power Company. The two boxes contained telegraph instruments connected with the terminals of the long circuits.

The Postal Telegraph and Commercial Cable companies had arranged to have their lines open for the transmission of messages, and a similar arrangement had been made with the Western Union and Central & South American Telegraph companies. The programme was that Mr. Depew should hand his message to Mr. Chandler, who should immediately put it on the Postal's lines, using the gold key which President Cleveland touched when he opened the World's Fair in Chicago. The route of the message was via Chicago, Los Angeles, San Francisco, Vancouver, Winnipeg, Montreal, Canso and London. From London the message was to be cabled to Lisbon and Gibraltar, Malta, Alexandria, Suez, Bombay, Madras, Singapore, Shanghai, Nagasaki and Tokio, and then to be repeated back to Mr. Edison's box in the Exposition hall.

The Western Union Company made up a circuit between New York and Galveston of about 10,000 miles, via Chicago, San Francisco, Los Angeles and St. Louis. At Galveston the message was handed to the Mexican and the Central & South American Telegraph companies, which transmitted it about 6500 miles, by way of Mexico, San Juan, Nicaragua, St. Eloma, Ecuador, Chorilles, Peru, Valparaiso, Chili, thence by land line over the Andes Mountains to Buenos Ayres, where it was handed to the cables of the River Plate, the

Western and Brazilian and the Brazilian Submarine Telegraph companies, about 6000 miles, via Rio Janerio, Pernambuco, St. Vincent, to Lisbon. From Lisbon it went over the cables of the Eastern Company, about 1000 miles, to Penzance, England; thence over the Western Union cables via Canso to New York about 4000 miles.

The messages over the Western Union lines were sent by Mr. C. A. Tinker, general superintendent of the Western Union Telegraph Company, who also received them back after they had completed their long journey, in a box in the middle of the main gallery.

It was after 8 o'clock when Mr. Depew, escorted by a committee of the officials of the Exposition, appeared in his box and was greeted by a round of applause from those in the hall. At half-past 8 o'clock he was introduced to the assemblage by Mr. Fish, and, after a few preliminary remarks, explaining that his presence there was to send a message around the world, he handed the following message to President Chandler, who at once ticked it off at the gold key in front of him, the message being addressed to President Adams, who was in the box on the opposite side of the gallery:

Edward D. Adams, New York.—God created, nature treasures, science utilizes electric power for the grandeur of nations and the peace of the world. CHAUNCEY M. DEPEW.

A moment after Mr. Chandler sent the following message, written by Mr. Adams:

Chauncey M. Depew, New York.—Mighty Niagara, nature's wonder, serving man through the world's electric current, proclaims to all peoples science triumphant and the benevolent Creator.
EDWARD D. ADAMS.

Both these messages were also put on the Western Union wires by Mr. Tinker, so that they were traveling around the world at the same time. The moment they were despatched that fact was announced by the firing of a gun on the roof of the Exposition Building.

In order to make the affair memorable, sections of the following famous circuits were incorporated into one circuit and interpolated in the lines of the Postal Telegraph Company, over which the messages were sent: First, a section of the wire over which Prof. S. F. B. Morse sent the first message by means of the Morse telegraph. Second, a section of the wire over which audible speech was transmitted by means of the telephone for the first time by Prof. Alexander Graham Bell. Third, a section of the Atlantic cable over which the first cable message was sent across the ocean by Cyrus W. Field. Fourth, an Edison plug and a section of the wire by which was lighted the first incandescent lamp from an electric lighting station. Fifth, section of the first trolley circuit put up at Richmond, Va., by F. J. Sprague. Sixth, section of the wire through which the current of electricity was sent by President Cleveland when he opened the World's Fair at Chicago. Seventh, section of the wire used in the first demonstration of vacuum tube lighting. Eighth, section of the cable through which the first current of electricity was transmitted from the Niagara Falls power plant. These pieces of historic circuits were loaned by Mr. William J. Hammer, of New York.

As President Chandler was ticking off the two messages an electric current was turned into a vacuum tube in front of the box to indicate that they were on their long journey, and, when it glowed with the hue of fluorescence there was enthusiastic applause.

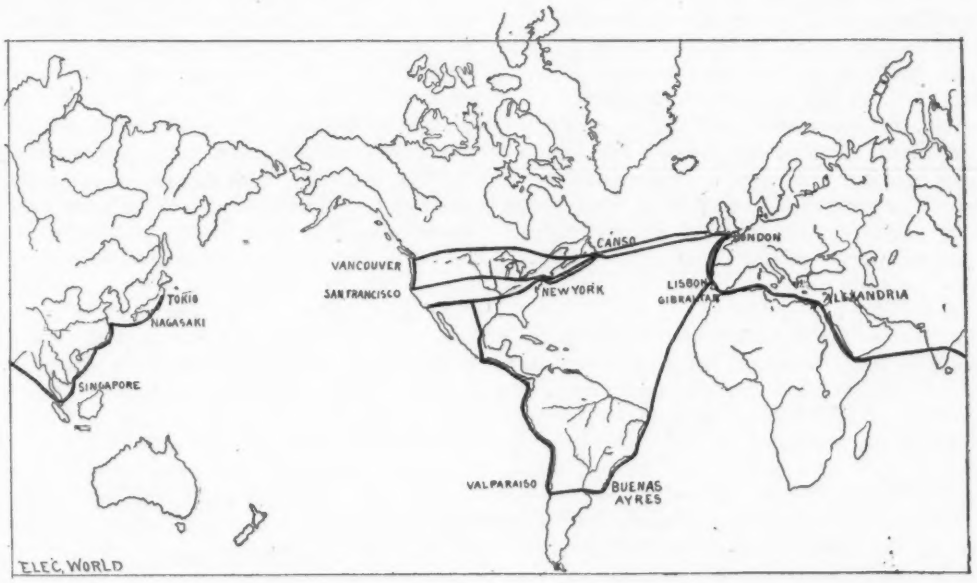
Mr. Depew then began the speech he had prepared for the occasion. It dealt with the wonders of electricity, and with the great strides that had been made by electrical progress and research. Among other things, he said:

Time will permit only a brief suggestion of the rapid introduction of electricity into every department of industry. It furnishes power for the mill and the machine shop. it is the motor for the railway carriages, it heats and it cools, it forges and it welds, and it extracts from the most stubborn ores ordinary minerals and precious metals. In our practical age the dividing line between the scientific toy and the profitable power is the cost of production. The price of coal limits the possibilities of settlement and the growth of cities. Industries and their development are dependent upon steam and electricity, and the generation of these forces upon coal. The most superb agricultural opportunities of the world are upon the Pacific coast, but the varied industries necessary for the support of a large population do not thrive there because the black diamond has not been discovered in the Sierra Nevada or the Sierra Madre.

This exposition illustrates another beneficent advance in electrical development. It suggests an opportunity of escape from territorial limitations of coal and the prohibitive cost of transportation. Wherever there are mountains and lakes there is water power. That this power can generate electricity has been known, but its usefulness has been handicapped because the mill and factory could not be readily transplanted. The most sublime concentration of continuing force in the world is Niagara Falls. We are here 450 miles from Niagara, and witnessing that power there can be conveyed here. It is a demonstration of incalculable value. It will redeem the waste places of the world. The tumbling torrent will become the treasure-house of nations. Wherever water flows electrical power may be generated, which transmitted great distances will create the mill, the factory and the furnace, and give that employment to capital and labor which relieves the farm-house of its surplus of boys and girls, and gives the farm the profitable market in a neighboring seat of population and industry.

He had been speaking but a few minutes when Mr. Edison announced in his box that the messages that had gone over the Postal and Commercial lines had gone through London, after traversing the American continent and crossing the Atlantic Ocean. Another gun was fired on the roof of the building at this announcement, and still another when, not long after, the messages were reported at Bombay. In fifty minutes from the time it was sent from the Exposition Hall Mr. Depew's message to Mr. Adams went to Tokio in Japan and was repeated back, the despatch being received by Mr. Edison.

President Adams' message, which left the hall at 8.40 was received back at 9.42.



MAP OF THE ROUTE OF THE TELEGRAPH CIRCUITS.

In the mean time Mr. Tinker had sent the messages over the Western Union circuit at 8.34 and had received them back at 8.58, after they had traversed this country and South America and crossed it and the ocean twice.

The first message to arrive was the Depew message, which had gone the South American route over the Western Union lines. It was received at 8.58 o'clock, having been 21½ minutes making its journey.

The next message that was heard from was the Depew message returning from Tokio. It had covered the journey to Japan and back in just 50 minutes.

The Adams message beat this by two minutes, coming in at 9.30 o'clock, and having been sent at 8.42.

A large outline map of the world hung from the gallery. The points at which the telegrams were repeated were indicated on the map by an incandescent lamp, in this way the audience were enabled to trace the course of the messages and appreciate the vast distances involved.

After all the messages had returned from their long journeys and the public ceremonies were over an elaborate supper, prepared by the Exposition officials, was enjoyed by Hon. Depew, Mr. Edison and other invited guests.

An immense crowd witnessed the interesting event of the evening.

Photography in Vacuo.

BY JOSEPH COTTIER.

The universal interest taken in Prof. Röntgen's discovery has been so great that Prof. J. J. Thompson's supposed proof of the non-existence of the rays in the vacuum itself has excited considerable comment. The only published account of this experiment which has come to the attention of the writer is that in Dr. O. Lodge's paper on "Present Hypotheses Concerning the Nature of Röntgen Rays,"[1] in which it is stated that "J. J. Thompson exposed a protected plate in the very rays themselves, inside a vacuum, and got no result."

This supposed evidence of the non-existence of the rays in the vacuum has been called in question by several writers. Dr. Lodge[2] has lately suggested that the exposure may have been so long, or the energy of the rays so great, that the plate had become, in the nomenclature of the photographer, "solarized"—*i. e.*, the first impression effaced by the long-continued action of the very rays that may have produced an initial effect.

Under the prolonged action of light the plate first reaches normal exposure, giving a negative upon development; passes to a first neutral stage, at which the plate is of a uniform dark tint; with continued exposure a positive results upon development. This condition is followed by a second neutral stage, the plate then showing no signs of development; this second neutral stage retreats before a second negative image. The quantity of light necessary for the formation of the second negative is variously estimated at from 100,000[3] to 1,000,000[4] times the amount of light needed for a correct exposure. This would place the second neutral stage at from 10,000 to 100,000 times the normal exposure. In other words, if on an exposure to chemically energetic radiations for one quarter of an hour no effect thereof were noticed upon development, the normal developable impression must have been reached, roughly speaking, at the end of from one tenth to one one-hundredth of a second.

The experiments referred to by Prof. Meldola were made in air; direct tests on "solarization" in a space devoid of air are wanting, but the production of this phenomenon in a vacuum does not seem probable, as Capt. Abney[5] has shown that oxygen is necessary for the reversal of the image, which does not take place either in the presence of reducing agents or under liquids devoid of oxygen.

The objection made by Mr. Osterberg[6] that photographic rays are not sensitive to actinic rays in a vacuum seems without valid foundation. There are so few experiments on the subject that one hesitates to state *ex cathedra* that there are no photographic plates which lose their sensitiveness in a vacuum, but the experiments previously made leave little doubt as to that fact. A few remarks on this matter have already appeared in the editorial columns of The Electrical World, March 28, 1896, and the following notes may serve to throw further light on it.

[1] The Electrical World, Feb. 26, 1896. London *Electrician*, Feb. 7, 1896.
[2] The Electrical World, May 2, 1896.
[3] Meldola. *Chemistry of Photography*, p. 215.
[4] J. Janssen, *Comptes Rendus*, Vol. xci., (1880) p. 199.
[5] *Treatise on Photography*, second edition, 1888, Chapter XXXVI.
[6] Röntgen Rays, *Electric Power*, April, 1896.

There are several theories of the production of the photographic image. It was stated by the Swedish chemist Scheele, in 1777, that the reduction product is a sub-chloride, or that the darkened silver chloride has lost chlorine without gaining oxygen; and Hunt's theory,[7] that the darkened salt has exchanged some of its chlorine for oxygen with the result of the formation of an "oxychloride" are the two most in favor. The physical theories, explaining the phenomenon of the latent image on the unstable molecular condition of the exposed or unexposed molecules, are difficult to entertain when it is remembered that an exposed and undeveloped plate will keep its impression for years without change.

A thorough review of all these theories would be tedious; suffice it to say that Hunt based his theory on an experiment showing that some of the oxygen had disappeared from the air surrounding the exposed chloride, while Scheele based his views on tests indicating the presence of free chlorine in the air above the darkened product. There is, however, nothing to show conclusively that the oxygen was not absorbed by the water in a compound of chlorine and oxygen. It is indeed true that Dr. W. R. Hodgkinson[8], Mr. H. B. Baker[9] and others have made experiments that seem to show the actual existence of oxygen in the "photo-product," but, unfortunately for the theory, while the amount of "photo-chloride" produced bears an exact relation to the quantity of light striking the silver salt, these experiments showing the ratio of the amount of chlorine liberated to the oxygen absorbed are wonderfully at variance with each other, and give rise to the impression that the change of the reduction product to an oxychloride may be subsequent to its formation by the action of light, a surmise strengthened by the phenomenon of solarization. A difference between the photo-salts produced in air, and in the absence of oxygen and water, has indeed been claimed by all advocates of the oxyhaloid theory, being the only way for them to account for the darkening of the chloride in a vacuum or under liquids which do not contain oxygen. Such a darkening has been observed, among others, by Mr. H. B. Baker[10] in dry silver chloride under both benzine and carbon tetrachloride, liquids which contain no oxygen; a similar result has been noted by Prof. Meldola[11].

All of these experiments point to the conclusion that oxygen is not necessary for the darkening of the silver salt or the production of a latent image. A more thorough discussion of this matter will be found in an article by Mr. Bothanley, Journal Camera Club 1890.

Neither does moisture appear to be needed, providing another absorbent of the evolved gas be present, for several experimenters have noticed that silver chloride darkens in a vacuum; Dr. Percy noticed it in a partial vacuum in 1844[12] and Capt. Abney[13] reported that pure dry silver chloride in a vacuum remained white, unless some chlorine absorbent were present. This is a result to have been expected, for in the absence of such an absorbent, the chlorine remains free in the vacuum, and the experiments of Dr. Percy[14] and others[15] show that free chlorine has the power of destroying the dark image and of bleaching the photo-product. Capt. Abney's suggestion was corroborated by Dr. Vogel,[16] who observed that if dry silver chloride were placed in one end, a drop of mercury in the other, of an exhausted tube, the chloride darkened, and a deposit of calomel was to be found on the walls of the tube, the mercury vapor acting as chlorine absorbent. This experiment has been repeated by others, although Mr. Baker[17] did not succeed in doing so, owing probably to differences in physical conditions or in mechanical arrangements. Prof. Meldola[18] gives an even more conclusive experiment, perfectly dry silver chloride, heated to incipient fusion, was enclosed in a tube and exhausted to a "Crookesian" vacuum, *i. e.*, to a vacuum suitable for the production of Röntgen rays. In this vacuum the chloride darkened quite as rapidly as in air, although it bleached again in the dark, showing a re-absorption of the chlorine.

[7] *Researches on Light*, second edition, 1854.
[8] Meldola, *Chemistry of Photography*, p. 55.
[9] *Photographic News*, 1892, p. 619.
[10] *Photographic News*, 1892, p. 620.
[11] The Photographic Image, *Nature*, Vol. XLII, 1890, p. 248. *Photographic News*, 1890, p. 581. Report Smith. Institution, 1890, p. 384.
[12] J. Spiller, *Photographic News*, 1890, p. 257.
[13] *Treatise on Photography*, second edition 1888, p. 23.
[14] J. Spiller, *Photographic News*, 1890, p. 257.
[15] W. J. Harrison, *Chemistry of Photography*. 1892, p. 189.
[16] *Handbuch der Photographie*, Vol. I, p. 154.
[17] *Photographic News*, 1892, p. 620.
[18] Photographic Image, *Nature*, 1890, p. 248. *Photographic News*, 1890, p. 581. Report Smith. Institution, 1890, p. 384.

This last experiment shows then that silver chloride does darken even in a "Crookesian" vacuum; but even with lack of this direct evidence, there would still have been no reason for assuming the non-sensitiveness of the plate therein, for according to the law of Vogel and Poitevin, referring more especially to silver iodide and bromide, the substances which make up the modern dry plate, it is a necessary and sufficient condition for the production of an image by the action of light, that there be an absorbent for the liberated iodine and bromine, and this absorbent is there, in the mercury vapor of the Torricellian vacuum, and especially in the gelatin support of the halogen molecules. Furthermore, if it be indeed true that absolutely dry gelatin cannot absorb bromine the latent image produced by light in a camera or by the action of the Röntgen rays requires so small a change in the constitution of the molecules that it is not at all evident how the infinitesimal amount of moisture needed could have been removed from its intimate contact with the embedded granules, even by exhaustion in a Crookes tube. The latent image only requires an exposure of one one-hundred-thousandth of a second to sunlight,[19] and the chemical change that takes place in that time cannot be very great.

Mr. Osterberg was probably not aware of the experiments of Victor Schumann on photography in a vacuum; made between 1888 and the present day. In a communication to the Vienna Academy[20] in 1893, Mr. Schumann announced his success in photographing the extreme ultra-violet end of the spectrum far beyond anything previously done. The shortest rays photographed would have been absorbed by a layer of air of 1 millimetre thickness, and the plate had therefore to be exposed in a vacuum in this series of experiments; the vacuum was such as to give a pressure of less than ½ millimetre of mercury, and as the slightest amount of moisture was found to be fatal to the rays of shortest wave-length, the apparatus and the air passed through it before exhaustion had been previously dried by prolonged contact with phosphoric anhydride. Two kinds of plates were used, an ordinary commercial gelatin emulsion dry plate, and a plate of special manufacture, consisting of a thin film of pure silver bromide and iodide on a gelatin sub-stratum.

The plates in the vacuum which was produced by a Sprengel mercury pump showed no diminution of sensitiveness over that in ordinary air. The complete account of Mr. Schumann's latest experiments has not yet been published, but from the notes which appear spasmodically in various periodicals it would seem that he has carried the exhaustion more than 10 times as far, without yet experiencing any difficulty from loss of sensitiveness.

The bulk of evidence is therefore to the effect that a sensitive plate retains its impressibility after removal of the air, and Capt. Abney's experiments lead one to doubt strongly that "solarization" could, under the circumstances, have taken place in the experiment performed by Prof. Thomson.

Blasting for Pole Line Construction.

Mr. I. J. Macomber contributes an interesting article on this subject to *The Sibley Journal of Mechanical Engineering*, for April. When the amount of blasting to be done is known to be small, says the author, it is only necessary to have in the regular line gang two or three experienced rockmen, who, when a rock must be cleared away, can readily do it with hand drill and blasting powder, but, if, on the other hand, the number of pole holes to be blasted out is large, a special gang of rockmen should be engaged to do the work. In such a case also, if the location of the route will allow of it, it is advisable to resort to steam drilling. This is not only more economical, but greatly hastens the work, an item of no little importance in most line construction.

For the purpose of firing dynamite cartridges the use of the magneto electric machine is in most cases best. When exploding by means of this machine cartridges are used which have the inner terminals of their leading-in wires united by means of a short piece of fine platinum wire. The electric current from the magneto machine heats the platinum wire to a temperature sufficient to explode the charge. The leads from the magneto machine should be a well-insulated copper wire, and at least No. 14 B. & S. gauge. The cartridges are connected to these leads in parallel.

Electrical Engineering Course.

A course of electrical engineering will be added to the curriculum of the College of Liberal Arts, Syracuse, N. Y. On June 10 the Board of Trustees will grant formal sanction to carry the proposition into effect.

[19] Meldola, *Chemistry of Photography*, p 135.
[20] Vienna Akademie der Wissenschaften, Sitzungsberichte, Math., Wissens. Classe 1893, Vol. CII., part 2, p. 625-694.

Results Accomplished in Distribution of Light and Power by Alternating Currents.*

BY W. L. R. EMMET.

(*Continued from page 572.*)

The great merits of the monocyclic system are that the number of conductors required for lighting and power distribution is reduced to a minimum, and that no unbalancing is possible. The operation of three-phase motors from this system is in all practical respects the same as when they are run from three-phase circuits.

Fig. 3 shows the connections of the two-phase system, with distribution by four conductors. Here the lighting is divided between two separate circuits, which must be kept balanced within certain limits, depending upon the regulation of the generator, or the amount of care that can be given to the adjustment of pressure on the different sides. Where motors are run, the two circuits must be brought together.

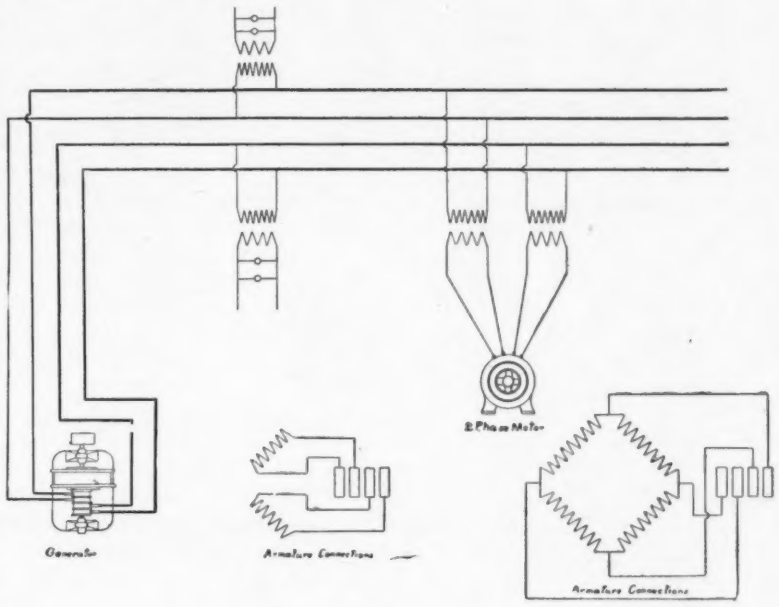


FIG. 3.

There is no economical and convenient way of operating secondary distribution from this system. Two independent three-wire systems could be operated, but these must be brought together when motors are to run. The complication of balancing such a system would be prohibitory.

The two-phase, four-wire system can be operated either from a generator with two independent circuits, or all four conductors can lead from one armature winding. Certain advantages may be claimed for both methods, and both have disadvantages.

Fig. 4 shows a method of single-phase lighting distribution from a two-phase dynamo. Here the two single-phase leads are taken out at points 180 degrees apart on a progressive armature winding. At points 90 degrees from those leads two other leads are brought out; each of the latter can be used with the pair of single-phase leads to run one half the capacity of the machine in two-phase motors. These two power loads cannot, however, be brought together.

The greatest disadvantage of this system is that when carrying a single-phase load a large proportion of the armature conductors are ineffective, and simply introduce useless resistance and self-induction in the circuit. Thus with the same loss the generator will deliver 42 per cent. more power as a quarter-phase machine than it will as a single-phase machine.

Fig. 5 illustrates the two-phase, three-wire system, which has been used to some extent both for high-tension distribution and for distribution by secondary mains. The principal advantage in this system is that it requires one less conductor than the four-wire, two-phase system. Its disadvantages are that the insulation of the apparatus is subjected to a voltage 42 per cent. higher than that which is available in transmission, and that the self-induction in the lines and transformers causes an unbalancing of the voltages on the two sides of the system, accompanied by the distortion of the phase variation. The extent of this unbalancing depends upon existing conditions, and is very different in different cases.

* A paper read before the Nineteenth Convention of the National Electric Light Association, New York, May 5, 6 and 7, 1896.

Fig. 6 shows diagrammatically the distribution of voltage with a given balanced load on a two-phase, four-wire circuit, and on the same circuit with one wire discarded, the third being used as a common return for the two sides of the system. AB and AC represent the two generated voltages on the four-wire, two-phase system. BB' and CC' represent the E. M. Fs. of self-induction in the lines of the separate two-wire branches of the circuit. $B'B''$, $C'C''$ represent the resistance drop in the two branches. AC' and AB', which are still at right angles, represent the two voltages at the end of the line.

The other diagram in Fig. 6 shows the condition on the three-wire circuit. AB and AC represent the generated voltages in quadrature.

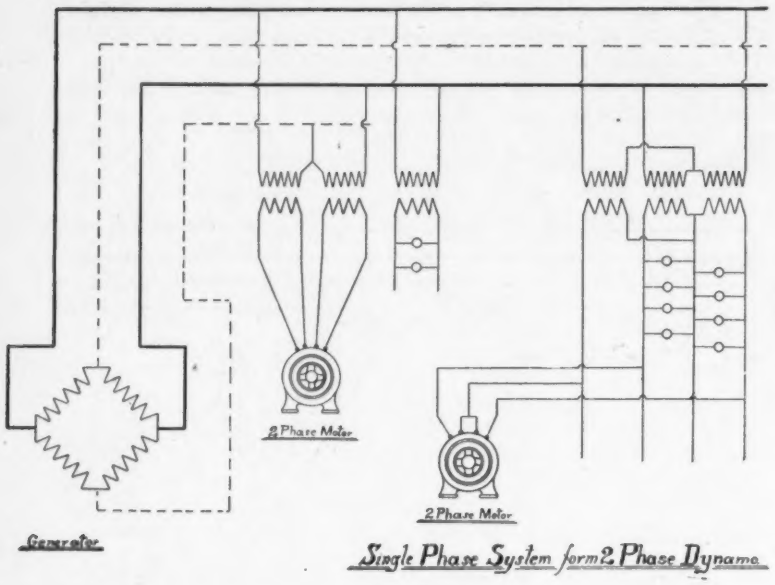


Fig. 4.

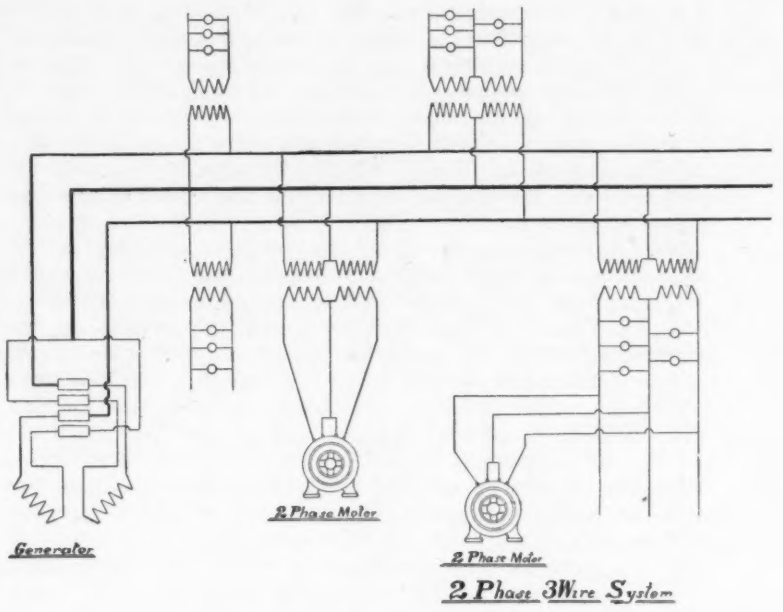


Fig. 5.

CC' and BB' represent the volts of self-induction in the outside conductors. $C'C''$ and $B'B''$ represent the volt's drop by resistance in these wires. AD is the resistance drop in the third wire and DD' is the E. M. F. of self-induction in the third wire. Since this wire carries 40 per cent. more current than the others, AD is 42 per cent. greater than $C'C''$, and $B'B''$ and DD' bear the same proportion to CC' and BB'. The lengths of $D'B''$ and $D'C''$ represent the voltages on the two sides of the system at the end of the line. The angle $C'D'B''$ is the phase relation of these two circuits and is less than 90 degrees. Thus with balanced load the sides of the system are neither equal or in quadrature.

The figures are so proportioned as to represent a circuit of "No. 00" B. & S. wire, operated at 125 cycles with 10 per cent. resistance drop on the four-wire system, and the same load and the same distance with three wires. With 1000 volts at the generator in both of these cases, we would have 850 volts on each side with the four-wire system, and with the three-wire system 730 volts on one side and 1030 on the other. This assumes aerial lines with ordinary spacing of wires. In addition to the systems above described for distributing power by induction motors, we have other means of power distribution by alternating currents. The synchronous motor, for certain classes of work, is highly efficient and reliable, and is extensively used, although it will not fill all the requirements of general power distribution.

The rotary converter also fills a very important place in the engineering work of the day.

A synchronous motor is simply an alternating dynamo whose functions are reversed. They may be used either on single-phase or polyphase circuits. In its simple form a synchronous motor has no power of starting itself on a single-phase circuit. On a polyphase circuit it starts with more or less torque as an induction motor, and will come to synchronism. As a rule, however, the starting of synchronous motors is not vigorous, and is accomplished by a large draught of current; hence their applications are limited.

A rotary converter is a synchronous motor of suitable construction, whose armature windings, besides being connected to collector rings, are also connected to a commutator. As the machine revolves at synchronous speed brushes collect direct current from the commutator, this current being partly rectified and partly generated by the machine. This machine deals in direct and alternating currents and mechanical power; supply it with any one of the three, it will deliver either one or both of the others. It is most efficient when filling its functions as a converter from alternating to direct currents. Its capacity is then greater and its efficiency higher than when it runs as a generator or as a motor.

To illustrate the use of the rotary converter, I will describe an application now under consideration. The company in question is operating three stations; one of these is very large and centrally situated, with condensing water and every facility for the cheap generation of current. Each of the other stations is about two miles from the main station; both work non-condensing. One of these stations delivers current only on the direct-current, three-wire system, while the other, in addition to similar work, carries a considerable arc-light load. In this case the following plan is considered:

At the two smaller stations rotary converters would be installed, and would deliver only direct current in one case, while in the other they would also act as motors to operate arc machines through a countershaft, to which they would be belted with clutch pulleys. Suitable step-down transformers would connect the rotary converters to a high-tension line leading to the main station. At the same station three-phase generators of large capacity would be installed. These generators would be designed to deliver both three-phase alternating currents to step-up transformers, and also direct currents

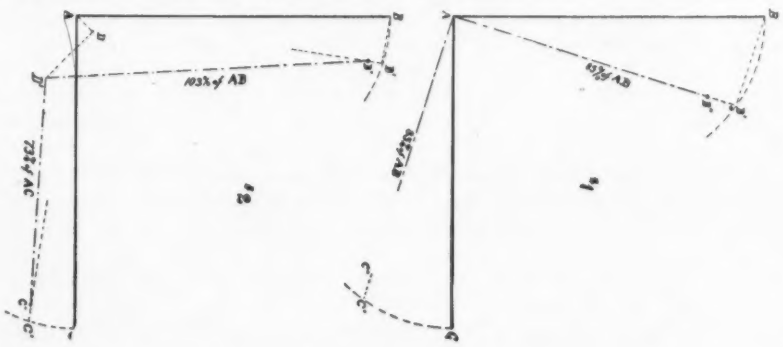


Fig. 6.

at about 250 volts to the outside conductors of the three-wire system. They would be directly coupled to engines. These machines would deliver current simultaneously, in any proportion, to the direct-current, three-wire system, to the rotary converter, or to lines distributing three-phase power.

It is proposed to operate these machines at a frequency of 25 cycles per second, this being well adapted to the direct-current work and also to three-phase power distribution.

In this plant an entirely independent control of direct-current pressure within a wide range would be necessary at the main and sub-stations. This would be effected without the introduction of idle currents, by the use of a novel form of three-phase induction regulator connected to the alternating leads of each rotary converter.

These regulators would give a wide range of adjustment without any moving connections, and would greatly simplify the operation of the plant, and also increase its economy, since the losses introduced by the regulators themselves are very small, and since conditions of general economy are always maintained. Thus a single engine could carry the whole load of the city at certain times.

Another interesting illustration of a combination of alternating and direct currents is found in a case now under consideration. A company controls about 3000 horse-power in water at a distance of 11 miles from a large town. It is proposed to install three-phase, 60-cycle generators in 600-kw units. The current from these generators will be transformed to 10,000 volts and carried over three wires to a city sub-station centrally placed. Here large step-down transformers will be installed, delivering current to 2000-volt lines, which extend all over the city and carry motors and lights in outlying parts.

In the same station two large Corliss engines are now in operation, and are belted to clutch pulleys on a countershaft, which operates some arc machines and other load. To this same countershaft it is proposed to couple with a clutch a large synchronous motor which will be connected to the 2000-volt lines. When the water supply is ample the engines will be shut down and the motor will run the shaft. When the water supply is low, or more power is required, the engines will be run and the synchronous motor will then act as a generator, running in parallel with the transmission line.

In the central part of the town it is proposed to install a system of three-wire mains and a large storage battery. This battery would be installed in a second sub-station, conveniently placed. It would be charged from a pair of direct-current machines, directly coupled to a synchronous motor operating from the 2000-volt lines. The direct-current machines would be used in connection with the batteries for supplying the three-wire system. The plan here outlined has many very positive advantages.

The pressure on the 2000-volt system can, within certain limits, be controlled at the sub-station by adjustments of the field of the synchronous motor. With telephone communication to the power house, the control will be perfectly easy. The peak of the lighting load being borne by the battery, the generators can be loaded nearly to their full capacity with motors during the day. At night they will charge batteries using water which would otherwise run to waste.

In both the plants described the cost of labor would be very small, one man being enough to operate each of the sub stations mentioned. The saving of labor in operation should be kept constantly in view in all engineering plans. Some of the greatest advantages in modern apparatus lie in its adaptability to such saving.

An infinite variety of conditions exists in different cities and the question of electrical distribution must be carefully studied in each case, in order that money may be invested to the best advantage. An intimate knowledge, both of the apparatus available and of the commercial conditions, is necessary to an intelligent decision in such cases. It is only through the exercise of intelligence and judgment of a high order that the best results can be obtained.

DISCUSSION.

Mr. Emmet said, in answer to a question by Mr. Wagner, as to the relative dimensions of single-phase and two-phase machines, that with a distributed winding over the armature and working single-phase, a large proportion of the armature was idle, introducing unnecessary self-induction and resistance, and, therefore, such an armature when used in a two-phase machine will work more effectively. This fact militates against the use of monocycle machines, since their windings are not distributed but concentrated, and thus made the most effective. The question of the design of the machine depends upon what regulation and armature reaction is wanted. In a machine with small armature reaction it makes little difference whether you have a small amount of idle wire on the armature or not; such armature losses are small, and the conditions for the losses in the machine are largely in the iron. Of course it is not economical to use too small an armature reaction, as you increase the cost of the machine, and it is at the same time desirable to use fairly large armature reaction in most cases where it can be done without trouble and with proper regulation.

Mr. Ayer said that it was interesting to know that a three-wire distribution system, with transformers located in manholes at intervals along the line, is producing successful results.

Mr. Van Trump brought up the question of having found a fluctuation in the lights on his synchronous motor service, although the generator was apparently running at constant speed. Mr. Emmet explained such action as being probably due to a variation in the prime mover, thereby causing a tendency of the motor to get out of step. This will produce a rise or fall in the voltage depending on whether the current becomes leading or lagging.

Mr. Scott stated that large transformers for supplying a number of customers will in general be more economical in the amount of power required for operation and also in the first cost, over the usual plan of supplying each customer by an individual transformer. The capacity of the large transformer may be less than the aggregate capacity of the small transformers which will be required. The cost of secondary mains may be prohibitive, however, if the district is a very large one, or if the service is underground and the cost of individual connections is high. This question is one which depends largely on the conditions. In general, he believed in the use of the secondary mains, and believed this will be found the most economical, except in very exceptional cases.

In a comparison of the three-phase and two-phase systems of distribution, he said one of the points which confront the customer is the measurement of the power on the two systems, both commercially for the sale of power and light, for determining what is going on in the system, the measurement of current in different branches or the measurement of power in different branches. The three-phase system is so interconnected that without elaborate or extended measurements or calculations, it may be impracticable to determine from the load on the three circuits what the relative load is, whereas on the two-phase system, where the circuits are independent in action, except to a very slight extent, the measurement of the current in one circuit would indicate the amount of current supplied to the devices connected with that circuit. In general, the amount of power measured directly in one circuit, added to the amount of power measured directly in the other circuit, will give the total power. If the conditions are a little abnormal, or something is wrong, the very time when the ordinary operator wants especially to know where the trouble lies, the two-phase system, with independent circuits, seems to me the best arrangement; and I know in some cases in practice, has given much less trouble with the ordinary electrician than the three-phase system does.

A method of secondary distribution which has not been widely used, but is being introduced, and it seems to me has a useful future before it, is the three-wire system, with a modification in which only two wires are run from the central station, or in which only two secondary mains may be required instead of three, which reduces the number of house connections required. In this case a 200-volt circuit might be used as secondary mains and two connections made to a customer. On the customer's premises, a balancing coil, a coil in the form of a converter, with a single winding, adapted for 200 volts, the two ends of the coil being connected to the 200-volt circuit, and a loop brought out from the middle of the coil, from which point 100 volts may be measured to either of the secondary mains, could be used for the connection of the middle or neutral wire. This coil would serve to preserve a balance between the two circuits, so that, should the number of lamps be greater on one circuit than the other, the E. M. F. would be practically balanced. This simplifies the three-wire system. The loss in balancing coils may be very slight. The balancing coil is a form of converter which will give a very large output, and its capacity need be only that required for the difference in the number of lamps on the two circuits. Let us suppose that there are 25 lamps on one circuit and 75 lamps on the other circuit, the capacity of the coil would then be 50 amperes, whereas the total number of lamps on the conduit would be 100. The size of the coil required for this difference in lamps would be the same as would be required for only 25 lamps, if made in the ordinary form of a two-coil converter, so that the cost of these secondary balancing coils need only be quite small.

The system of two-phase distribution mentioned by Mr. Emmet, in which the generator is wound with closed circuit and the terminals brought out at either four points, two being used for single-phase lighting, and one of the other leads being used in connection with motor work, requires the use of but three wires to any point where motors are required. The use of four wires here is usual in many cases for motors, if the power required by the motors be large. The effective potential of distribution for motors is about 700 volts upon each of the two side circuits, if the lighting be done at 1000 volts, and the motor be run from three wires; but if all four wires are used, then the effective potential for motor service is 1000 volts in the transmission line on each of the two circuits. Thus, if the quantity of power to be delivered by the motors is considerable, the use of four wires may lead to a saving in the cost of conductors, making it well worth

while to run them. This kind of generator admits of this connection very readily. The only disadvantage of this system that has been pointed out, but is said to be the greatest one, is the reduced capacity of the generator. That point has already been discussed. It is usually satisfactory to the customer to know that he can buy a dynamo for a certain price to do a single-phase work, regardless of what the dynamo may do if operated in some other way.

The supplying of motors from a dynamo of this kind by three wires involves the two-phase three-wire system, in connection with which the unbalancing of the two circuits has been pointed out. This unbalancing will tend to unbalance the motor circuits, raising one and lowering the other. This system is best adapted for a large percentage of lighting load, with a motor load as an auxiliary, as is the case in general station practice. In that kind of service the unbalancing of the two circuits does not affect the lighting part, where closeness of E. M. F. is required, but affects only the motor work, where the E. M. F. is not required to be adjusted with the same nicety. With a motor load, the unbalancing is not quite as great as it is on lighting loads, due to this mutual induction between the two circuits. The effect of the unbalancing in the example in the paper is extreme, and results largely from the high frequency of 125 cycles. At low frequencies the effect would be very greatly lessened.

I desire to re-enforce what is said in the latter part of the paper about the flexibility of the alternating system, coming into actual practice. You have heard about the flexibility of this system for a long time; its adaptability to all kinds of service. The example given in the latter part of the paper shows how that is being done at present on a large scale, and the Hartford, Conn., plant is one that has come to my attention lately, and I have gone into the details of it. One machine may act as a generator, driven by an engine, supplying power to the city, or it may be run as a generator in multiple with machines at two different stations, 10 miles away, or which may be run as a synchronous motor for replacing the engine, showing a flexibility which ought to find application elsewhere. The running of this current through rotary transformers, for supplying storage batteries, is also an application which ought to be adopted elsewhere.

I have heard this plan criticised on one ground, and that is that it does everything, except that the storage batteries do not run back through the rotary transformers and alternating-current motor and make steam in the boilers.

Mr. Emmet said that, owing to excessive unbalancing at times the compensators which Mr. Scott had suggested would have to be larger than he had indicated; in fact, as large as one quarter the capacity of the lights. These compensators have a low efficiency, and if their regulation is good and they fulfill their functions properly the core losses will be large. He thought that their use might be advisable to help out some remote point, but not for general use.

Mr. Dow said that he used the largest transformers possible, and when the conditions were such that it was a question between cost of secondary mains and transformer, he took the transformer.

In regard to the use of alternating-current arc lamps, Mr. Wagner said that he has successfully run 75 lamps from a transformer. Such a system, if once perfected, will permit of the operation of motors and both arc and incandescent lamps from the same secondary low-potential mains.

Augmenting Röntgen-Ray Effects.

Dr. Philip Mills Jones, San Francisco, has found that with the particular type of tube having a cup-shaped cathode and a small piece of platinum inclined at an angle of 45 degrees to the axis of the cathode and used as an anode, that there exists two spots on the tube which, if covered with small patches of tinfoil and grounded, the Röntgen-ray emanations will become far more intense than would otherwise be the case. These two spots were found to be, one just below the cathode and at the back of the tube; the other just below the lower end of the anode and in front.

Effects of Competition.

A German contemporary states that five years ago it was considered very satisfactory to manufacture 500 to 800 incandescent lamps a day with 100 horse-power, but to-day it is possible with 10 horse-power and 55 workmen to manufacture over 2,000 incandescent lamps a day and pack them ready for shipment.

Equalizer Systems of Distribution.*

BY A. CHURCHWARD.

In preparing the following paper, the limited scope of which is indicated by its title, I have assumed that a three-wire system is supposed to be the only safe and reliable system of direct-current distribution for motors and lights in our cities.

It is my intention to refer to the many methods that have been devised to accomplish the results obtained by the three-wire system

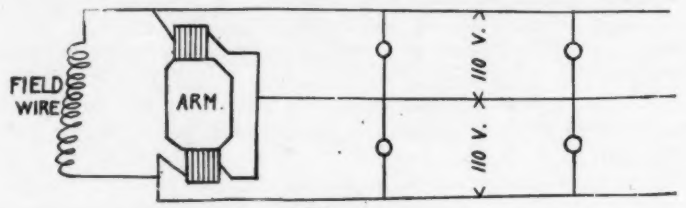


Fig. 1.

without the use of a divided source of electrical energy, and a compensating conductor connected to the point of division.

The following is an abbreviated list of such methods:

First.—Using a single dynamo with two commutators. Very little would be gained by this, even if it did not infringe the above system, as one commutator on a large machine is all most people can put up with.

Second.—It does not seem probable that at this late day any one

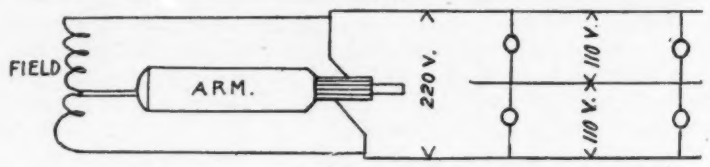


Fig. 2.

is likely to try the combination of a 220-volt dynamo and two sets of lamps connected in series by a third wire.

Third.—This time we come to a true system of equalizer distribution. We have only one generator, *A* of, say, 220 volts, and two small machines, *C* and *D*, capable of taking care of the unbalance due to turning off lights on either side of the circuit, and a

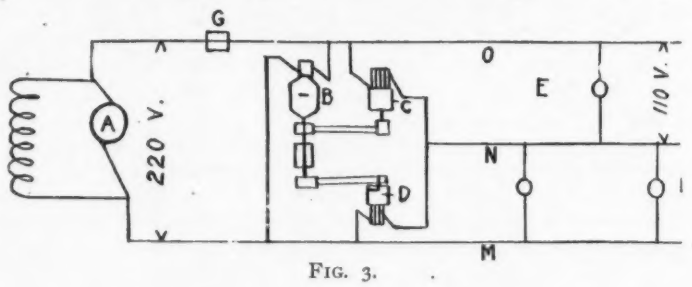


Fig. 3.

motor, *B*, connected to the two outside mains and driving the two machines *C* and *D*.

In this system the comparative loss is quite great at light loads, as we have a constant loss due to friction, field currents, eddy and foucault currents of three machines. Another disadvantage is the difficulty in keeping the system properly balanced, owing to drop in speed of motor with increase of load, and a drop in voltage of one

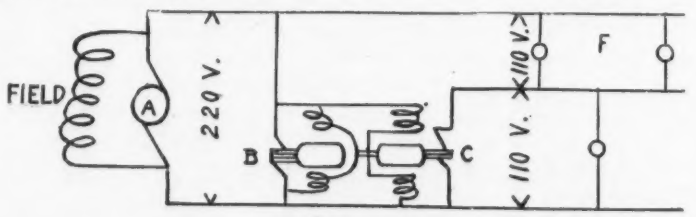


Fig. 4.

of the machines *C* or *D* when running as a dynamo (due to armature reaction and C-R losses in the armatures), and, on the other hand, the load being taken off, the voltage rises on the lightly loaded side.

The action that takes place is this, and will be found nearly the

*A paper read before the Nineteenth Convention of the National Electric Light Association, New York, May, 5, 6 and 7, 1896.

same in all equalizer systems: When both sides of the circuits *E* and *F* are equally balanced, the motor *B* runs free, only taking enough current to keep *C* and *D* up to the proper E. M. F. Should the load be changed, however, so that *F* had 20 amperes and *E* 10, then there would be unbalance of 10 amperes. An ammeter placed in the circuit at *G* would indicate 15 amperes, the amount of current to run combination *B*, *C* and *D*. Fifteen amperes would flow from the mains *F M* to *N*, and the machine *D* would act as a dynamo and supply the other five amperes. On the other hand, the machine *C* would take the five amperes from the neutral *N*, and run as a motor, helping to drive the motor *B*. Thus it can be seen that under ordinary conditions we can dispense with the motor *B* and couple *C* and *D* together, as shown in Fig. 4.

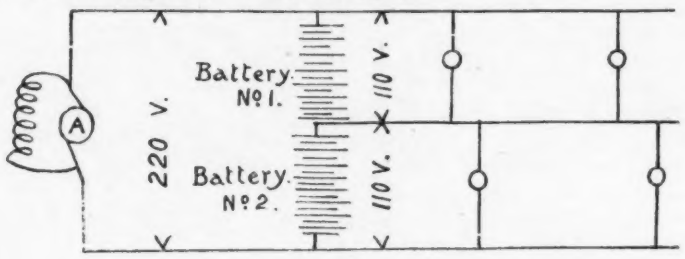


FIG. 5.

By using the motor *B*, a greater load on one side can be taken care of.

Fourth.—A single dynamo, 220 volts, *A*, and a small machine of 110 volts, *C*, driven by a motor *B*, connected across the 220-volt mains.

The motor *B* drives the machine *C* so that the pressure across *E* and *F* are equal; should the load be increased on *E*, the pressure will fall and the machine *C* will supply the extra current needed to balance the pressure; if the load on *E* is less than on *F*, then *C* will run as a motor, driving *B* as a dynamo. In this case also there will be a slight unbalance of pressure, due to armature reaction, etc.

Fifth.—Still another method has been proposed. This employs a

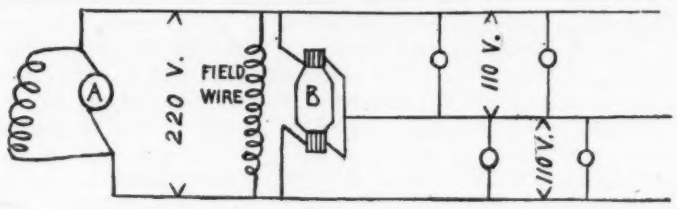


FIG. 6.

single dynamo of 220 volts. To the brushes of this machine are connected the two outside wires, the neutral wire is connected to the centre of the armature coils, and this raises a potential midway between the two outside wires.

Sixth.—A system in use in central stations in Europe might be mentioned here, but we can hardly call it an equalizer system. It consists of a 220-volt dynamo and two sets of batteries. The accumulators here play the same part as their namesakes do in a system of hydraulic supply.

The battery connected to the circuit that requires most current discharge into the circuit and thus helps the dynamo and the battery in which the demand is smaller is charged by the

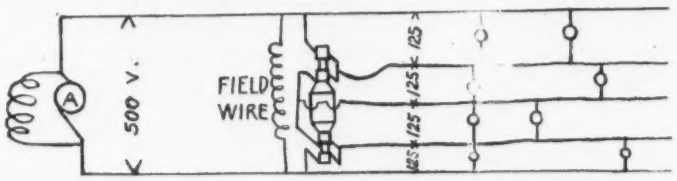


FIG. 7.

surplus current. There is no economy in an installation by this method over others, the accumulation costing much more than a rotary equalizer. We gain this much, however, during the hours of light load the batteries may supply all the current required, permitting the shutting down of the central station during those hours.

Seventh.—I intend now to bring to your notice an equalizer that has passed the experimental stage and has been in operation day and night for two and one half years; no lamps have ever been lost owing to lack of balance of the system.

Again, we require but one generator, *A*, of 220 volts, and one small machine with two commutators, *B*. We have only two bearings to worry about; only one field loss; one loss due to hysteresis and eddy currents, and absolutely no armature reaction. There being no armature reaction, there will be no drop in speed, no sparking at the brushes with a change of load, and the capacity of the equalizer will be the heat limit of the armature winding. By using the equalizer system we have one unit, or set of units, running at a high efficiency, and for a reserve we have only one machine.

It is not limited to only 220 volts. Where a company has a motor trade much scattered, they can take, for instance, 500 volts and run a good distance with economy, then put an equalizer in a central location and supply your customers with lights at 110 to 125 volts.

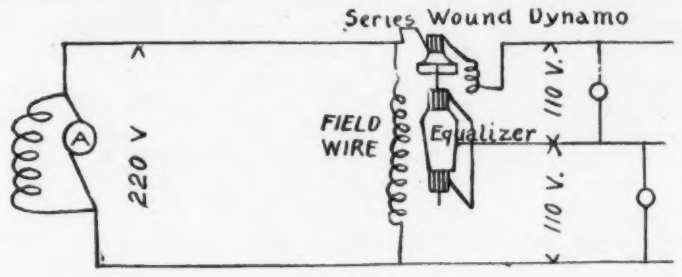


FIG. 8.

Or, again, if we want light and power in one unit, we can take one generator of 50 kilowatts and 250 volts and a motor of 50 horsepower; but with two commutators; or, in other words, on a 50-hp equalizer we can take either the full load in power off the pulley or the full number of lights off one side at 110 to 125 volts, or in any proportion we see fit.

Still another advantage of this system, we can always compensate for the drop in our line at any point independent of all others. This we might call a booster equalizer system. When the heaviest loads are on our system and the sides balanced, all the equalizer does is to run free as a motor. Now, by attaching a small series-wound dynamo to the end of the shaft of the equalizer, and adjusting it to the load and drop, we will first boost our pressure and then equalize it. So that, given a district with various points of distribution and various drops, we can run even the longest and heaviest loaded circuit at the same pressure as our station E. M. F.

The Evolution of the Arc Lamp.*

For the purpose for which it is intended to be used, the arc lamp, as we commonly know it, is, mechanically and electrically, the poorest designed and constructed piece of mechanism on earth." After this somewhat startling statement the author proceeds to justify it by giving a history of the arc lamp from its earliest beginnings to the present time. The gist of this is that the arc lamps of to-day, notwithstanding the large number of inventions and improvements which they embody, are still crude devices with many faults. They are very long, but only 36 per cent. of this length is available in the form of consumable carbon, whereas with the constructions which the author advocates, 80 per cent. of the total lamp length is made available. He states that the present forms of arc lamps are full of complicated mechanism, much of which may be dispensed with. The author very pertinently states that in 2711 central lighting stations in the United States there is invested $320,000,000 solely to get light. Bearing this in mind, the lamp is the object of first importance, building and other machinery being of importance only indirectly as parts of the plant necessary to actuate the lamps, and yet of all the apparatus the lamp is the very crudest. Of all the troubles in the present lamps, he says the commonest is the slipping past each other of the carbons. After this come scores of other troubles, most of which are referable to the carbon rod, which is also the cause of the excessive length of the lamp. The author's idea is to dispense with the carbon rod altogether, feeding the carbon by a chain and sleeve, the chain weighing the same inch for inch as the carbon. In this lamp, as the carbon burns away and feeds, the consumed length is replaced by an exactly equal length of chain, and the balance is in no way disturbed.

By properly adjusting the sizes of upper and lower carbons, they may be made to burn off an equal length in a given time, and then by attaching to the lower carbon the lower end of the chain which feeds the upper carbon, the arc is kept stationary, which is an

* Abstract of a paper read by L. H. Rogers before the Nineteenth Convention of the National Electric Light Association, New York, May 5, 6 and 7, 1896.

advantage for many reasons. It not only looks better and gives a better distribution of light when placed centrally in the globe, but it is much less liable to crack the globe by unequal expansion. Moreover, when the arc is stationary at any point, it permits of the carbons being held flexibly at the ends, and guided near the arc by metal or other guides in such a way that it is impossible for their points to slip past each other. The author states that in the shortened lamp longer carbons may be used, burning 16 hours if necessary, thus avoiding the necessity for double carbon lamps, which were only provisionally allowable at best, when we had no other means of constructing a lamp that would burn all night, and also that the lamp may be made of cast iron in such a form as to avoid the necessity of a hood. The sizes of carbons recommended are for 8.9 or 10 amperes, ⅜ inch diameter, 14 inches long for the upper, and one half inch diameter and 12 inches long for the lower. These, the author says, will burn 14 to 16 hours, leave equal stubs, and keep the arc at practically the same level. The small lower carbon lets out the light better than one of equal size with the upper, besides which there is more light produced to begin with, when the sizes of carbons are properly adjusted to the strength of current. The author condemns any unnecessary opaque substance in the path of the rays. He says that with one pair of carbons burning 16 hours, we need have only one single arm of small cross-section reaching down to sustain the globe holder. The shadow from this arm can be thrown directly against the pole or building, leaving absolutely unobstructed light for the street. The lamp should be so arranged that the trimming of the carbons and cleaning of the globe may be done without removing the latter. The concluding portion of the paper we quote in full as follows:

It is a very noticeable fact that those who have had the most intimate acquaintance with arc lamps and have operated practically the largest lighting stations for the longest time, are the men who are the most eager to hear of a lamp constructed on new principles.

The West Side Park, Chicago, is about purchasing a large arc lighting plant—one of the largest ever installed at one time. They want 750 arc lamps. The specifications drawn by their engineer, Mr. Foree Bain, were received by the author a few days ago. They are sufficiently unique to be preserved. His idea, the author thinks, is new. He asks a number of questions. The bidder is to answer these questions on blanks furnished—said answers to form the guarantees of the bidders.

These specifications read as follows:

Single or double carbon? Size of carbons? ..... Upper, Lower..... Cross-section? Market price of such carbons per 1000? Length of time the lamp will burn with one trimming, in circuit of 9.6 to 10 amperes and a difference of potential of 45 to 50 volts at terminals of lamps? With 6½ amperes and 45 volts? Will the lamp burn at a practically constant voltage of 45 to 50 volts, while the current may be changed from 9.6 amperes to 6½ amperes? If not, what range do you guarantee? In stating guarantees above, do you refer to the use of plain or plated carbons? State make of carbons referred to. If such carbons are covered by patents, making them a monopoly, state price per 1000 you hereby guarantee they will not exceed for a period of five years from date hereof? By what means are the carbons adjusted to a co-axial position? By what means are they maintained in a position co-axial with regard to each other?

What is the extreme length of lamp?

What is the weight of lamp with globe, trimmed and hung ready for operation, with hood and hanger board, if such be necessary?

How many side rods for supporting the globes and negative carbons?

Diameter of each intercepting the rays from the arc? Length?

Is it necessary to remove or disturb the globe when trimming the lamp?

Does your lamp require a special globe? If so, at what price do you guarantee they will not exceed for a term of five years from date?

Of what material is the jacket or case composed? How removed for inspecting the operating mechanism?

Is the lamp shunt or differential?

After the arc is struck, is the series coil retained in circuit?

Is its responsive mechanism in continuous active motion?

What is the electrical resistance of the series coil and its connections?

What is the resistance of the shunt coil? Of what size wire is it composed in decimals of an inch?

How many active pivotal joints in operative mechanism? How many springs in the lamp? How many variable adjusting devices are there in the lamp? Are they sliding or pressure? Of what metal composed? Maximum current carried? Can they be readily replaced? Will the automatic cut-out re-establish the arc when the carbons come together?

Within the limit of what number of volts can the cut-out be adjusted to positively operate? If a double lamp, what is the difference of voltage between two pairs of carbons when in normal operation? Is any resistance cut into the main circuit when the lamp automatically cuts out? How many ohms? What is the form of cross-section of the carbon-feeding rod? How is the circuit completed through the rod? What is the area of surface contact of the clutch with the rod in decimal of square inch? What is the voltage and current at which the lamp is best adapted to operate? State the maximum and minimum voltage between which the lamp will operate and feed in practical service, during a period of six months? Mention any special features of your lamp.

The man who could ask those questions is hunting for an arc lamp different from the ordinary. They show that he has fought and bled with a multiplicity of spools, springs, rods, sliding contacts, lapping carbons, broken globes, and rusty sheet iron cases, and that he has lived within the dark shadows thrown by the old style lamps, and gazed for years upon landscapes marred by the contours of the arc lamps of the period of 1875 to 1895.

The Commercial Value of Acetylene Gas as an Illuminant.*

The first part of Mr. Ferguson's paper was devoted to a description of the process of manufacturing calcium carbide, from which acetylene gas is produced; also to a test made by himself, together with Mr. George O. Knapp, of Chicago, and Mr. T. L. Willson and Major Morehead, of Spray, N. C., for the purpose of determining the actual production of calcium carbide per horse-power per day, and the volume of acetylene obtainable per pound of carbide. He also referred to the method of producing acetylene from the carbide and the properties of the gas, its great candle-power and its low temperature.

Having seen how the calcium carbide and acetylene are made, and having considered their properties, the question now before us, he continued, is the cost of producing them. The results of the tests made at Spray, and before described, show that 8.3 pounds of carbide is produced by each electrical horse-power in one day, or .463 pounds per kilowatt-hour; also that the efficiency of production was 58.4 per cent. Experience at Spray shows that the carbons used as electrodes last about 70 hours with the same amount of energy as used in this test. The cost of these carbons is $2 each, which approximates 6 cents per pound, or 18 cents per kilowatt-hour. The cost of lime I have put at $5 per ton, and coke at $2.50 per ton, these figures being about the average prices for these materials of good quality, and considerably less than the actual cost of them at Spray.

The question of the cost of electrical energy is the all-important one, so that I have taken the Niagara price of $20 per electrical horse-power per year of 8760 hours, considering this to be the lowest commercial price obtainable at the present time, and one which offers no question as to its accuracy, it being one which is absolutely tangible. The estimate is further based on the assumption that the carbide plant is to be operated at full load 24 hours per day and 365 days each year, so that the actual cost per electrical horse-power-hour of energy consumed may not exceed $20 divided by 8760, which is .238 cent or .317 cent per kilowatt-hour. With this data as a basis, the cost of producing one ton of calcium carbide at Niagara Falls, in a plant having 10 200-kw furnaces, producing 10 tons of carbide per day, would be as follows:

POWER.		
4320 kw-hour at .317 cents per kw-hour.....		$13 69
MATERIALS.		
2085 pounds of lime at $5.00 per ton		5.21
1339 pounds of coke at $2.50 per ton.....		1.67
CARBONS.		
Carbons for 4320 kw-hours at .18 cents per kw-hour.....		7.78
SUPERVISION AND LABOR.		
Operating 2 shifts 12 hours each:		
1 superintendent, at $5.00	$5.00	
1 chemist, at $4.00.....	4.00	
2 foremen, at $2.50.....	5.00	
10 regulating men, at $1.00	10.00	
6 furnace men, at $1.50.....	9.00	
2 grinders, at $1.50.....	3.00	
6 laborers, handling and grinding and mixing, at $1.50...	9.00	
	$45.00	

* Abstract of a paper read by L. A. Ferguson before the Nineteenth Convention of the National Electric Light Association, New York, May 5, 6, and 7, 1896.

Labor per ton 45 + 10		$4.50
Cost of barrels and preparing carbide for shipment		1.00
		$33.85
Interest at 6 per cent. on $25,000, the investment necessary to erect the factory, furnaces, crushing and mixing machinery, apparatus for handling and regulating	$1500.00	
Depreciation on $25,000 at 5 per cent	1250.00	
Taxes at $10 per M	250.00	
Insurance at $3 per M	75.00	.84
	$3075.00	
Cost of production at Niagara		$34.69
Freight from Niagara to New York, Philadelphia, Boston or Chicago, at 15 cents per C pounds		3.00
		$37.69

This estimate of cost per ton of calcium carbide is intended to represent the cost of manufacture to a large gas company operating in New York, Boston, Philadelphia or Chicago, with its calcium carbide works at Niagara, and whose business would be to produce acetylene from the carbide in the city where the gas is to be used, and to distribute it to its customers through its existing mains. It is not intended to represent the cost cleared off its books of any corporation or firm whose sole business would be the manufacture of calcium carbide for the market, for to cover that case we must add to the above estimate the cost of general expense including administration, royalties, and selling expenses, which of necessity would be equal to a large percentage of the factory cost as given. Let us then consider the value of acetylene to the gas companies in large cities: In many articles and circulars treating of this question, it has been customary to place the actual cost of acetylene as produced from the carbide, taking the factory cost of the carbide as a basis, against the selling price of illuminating gas at $1.00 per thousand cubic feet. This, of course, is not a fair comparison and is very misleading. Believing that the only fair way to consider the relative value of acetylene and water gas is to compare them upon the basis of cost per candle-power hour in the holder, and assuming that the cost of distribution is the same in each case, I will treat the question on that basis:

We have seen from the results of the tests at Spray, that for each pound of carbide we obtained 5.24 cubic feet of acetylene, or 10,500 cubic feet per ton; therefore, the cost per thousand cubic feet of acetylene would be one-tenth the cost of one ton of calcium carbide. The candle-power of acetylene being placed at 240 for each 5 cubic feet of gas, and the candle-power of water gas in the large cities at 25 for each 5 cubic feet of gas, it will be seen that the candle-power of acetylene is 10 times that of water gas per thousand cubic feet, and, therefore, the cost of acetylene giving the same candle-power as water gas would be equivalent to water gas at a cost per thousand cubic feet equal to $\frac{1}{10}$ of the cost per ton of calcium carbide. For example, if the calcium carbide costs the gas company $100 per ton, then the cost of acetylene gas in the holder will be equivalent to 25-cp water gas costing $1.00 per thousand in the holder.

The present average cost of illuminating gas in the holders of the large gas companies approximates 30 cents per thousand cubic feet, while the cost of acetylene gas in the holder, with calcium carbide at $37.69 per ton, would be equivalent light for light to illuminating gas at 37$\frac{7}{10}$ cents per 1000 cubic feet, making the cost per candle-power hour of pure acetylene approximately 20 per cent. higher than that of ordinary illuminating gas. If acetylene were mixed with air and distributed the cost would be less. This has been done in an experimental way, using 60 per cent. acetylene and 40 per cent. air, but the advisability of attempting to distribute such a mixture through a system of mains in a city for commercial use is exceedingly questionable, owing to the risk of the mixing being improperly done, and the quantity of acetylene falling to such a percentage as to form an explosive mixture.

It has been suggested that the cost of distribution, as well as the cost of mains and maintenance, which constitute a large portion of cost in the lighting industry, might be saved by the use of liquid acetylene, put up in cylinders and delivered to the stores, residences, and offices, so that the consumer might generate his own gas as required. It appears to the writer that this method is an entirely impracticable and uncommercial one, as there are almost insurmountable objections to be overcome. Neither the average business man or the occupants of a residence wish to be bothered with the care necessarily attendant upon the use of the cylinders of acetylene. It would be necessary either to have two cylinders ready for service, or to have a second one placed in service before the first one was exhausted, and in all probability the busy man would find himself in darkness at the time when he most needed the light, owing to the fact that he had neglected to renew his cylinder. The pressure of the gas in these cylinders is from 600 to 700 pounds, so that it is necessary to use a reducing valve which will give a pressure of one ounce. The same valve which is used with the Pintsch system of railway lighting is employed, but this in all probability would not be kept in condition by the ordinary householder or storekeeper, and the consequence would be that the full pressure might be impressed upon the pipes, and in case this were prevented by the use of an auxiliary safety valve, then every failure of the reducing valve would allow all the gas to escape and be lost. The use of acetylene cylinders would increase the danger in case of fire, since the gas would escape should the cylinders become heated, and explosions of the mixture of acetylene gas and air would possibly follow. After considering the many inconveniences and dangers in the use of liquid acetylene in the business and residence districts of the large cities, it leads the writer to believe that acetylene to be commercially successful must be delivered to the customers in the form of gas through a system of mains, as is done now with ordinary illuminating gas. Liquid acetylene should find a field in the lighting of country estates, railway trains, and for use in carriage, bicycle and locomotive head lamps, and in isolated places where distribution by mains is not possible.

When acetylene was first brought forward to be used commercially, it was expected that the gas companies might still maintain their existing gas works and use acetylene to enrich their gas, and furnish a 25-cp flame as formerly, but at a much less cost. Experiments have shown, however, that although coal gas may be enriched by acetylene, water gas is not susceptible to enrichment by it. Water gas, which is furnished in nearly all the large cities, has little illuminating power of its own, is now treated with petroleum, and it is only when enriched to a certain candle-power that acetylene may be mixed with it without losing its candle-power, so that we cannot, as at first supposed, substitute acetylene for petroleum and use it economically as an enricher of low candle-power water gas.

It has been suggested that the manufacture of calcium carbide might be carried on by the central-station electric-lighting companies as a by-product, furnishing the energy necessary for its production during the hours of light load upon the lighting system, thus bringing the load curve of the station nearer to a straight line, and thereby improving the economy of the station operation. It will be readily seen from the figures given in the estimate of the cost of producing the carbide, that the cost of power is a very important factor, and if we increase the cost given, of $20 per horse-power per year, we will correspondingly increase the cost of the carbide. From experience with the cost of operation of the largest central lighting stations in this country, the writer can safely state that the absolute cost of fuel alone in the most economically operated lighting station of the most modern type of multiple expansion condensing plant averages .3 of one per cent. per kilowatt-hour, or approximately $20 per horse-power per year continuous service, while the total cost of generation in the station would average over double that amount. In the average of the large central stations the generating cost at the switchboard, without distribution and general expenses, approximates one cent per kilowatt-hour, which is about $65 per horse-power per year, and in the smaller stations using steam, double that amount. It is obvious then that we may not hope to use our present central stations during minimum hours for the manufacture of calcium carbide as a by-product while the cost of power in our stations remains as it is at present, and the amount of power required for the production of carbide so excessive, as the cost of its production by the central station would be prohibitive. It would be much better and more economical for the central station manager to sell his electrical energy through the incandescent or arc lamp at the same price per kilowatt-hour than to use the energy for the production of carbide, since the cost per candle-power-hour would be less when the electrical energy is converted into light directly through the incandescent and arc lamps than through calcium carbide and pure acetylene, assuming the cost of distribution and general expense to be the same in each case. Take for example, carbide at $40 per ton, which means 40 cents cost per 5000 cp-hours of acetylene gas in the holder, or 125-cp hours for 1 cent. Compare with this electrical energy at the switchboard at 2 cents per kilowatt-hour. For each kilowatt-hour generated we obtain twenty 50-watt incandescent lamps, each giving 16 candle-power, making a total of 320 cp-hours per kilowatt-hour, or 160 cp-hours for 1 cent, which is 28 per cent. more candle-power for the same expenditure of money by the use of the incandescent lamp directly as a con-

verter of electrical energy into light as against the conversion by means of carbide of calcium and acetylene.

If we take the case of the arc lamp and add to the cost of the electrical energy 1.5 cents per kilowatt-hour for carbons, trimming and lamp repairs, making the total cost 3.5 cents per kilowatt-hour, we find it still more advantageous. Assuming a 500-watt arc lamp gives 1000 candle-power, we have 2000-cp hours per kilowatt-hour, or 575-cp hours for 1 cent, which is 4.6 times the illumination for the same money as compared with pure acetylene gas. Taking the cost per kilowatt-hour at the switchboard in the large central stations, we obtain 320-cp hours for 1 cent, which is 156 per cent. more candle-power for the same expenditure of money by the use of the incandescent lamp directly as a converter of electrical energy into light as against the conversion by means of carbide of calcium and acetylene. By means of the arc lamp on the basis of cost of 1 cent per kilowatt-hour for electrical energy, and 1.5 cents per kilowatt-hour for carbons, trimming, and lamp repairs, we obtain 800 candle-power for 1 cent, or 6.4 times the illumination for the same money as compared with pure acetylene gas.

From these deductions and considerations, gentlemen, it may be concluded in the light of our present knowledge, and upon the basis of the estimated cost of production of the calcium carbide, that acetylene gas should not drive the incandescent and arc lamp from the lighting field, neither should it make such inroads on the electric lighting business as to materially affect the earnings of existing central station companies, for after all acetylene is a gas and burns with a naked flame, and the use of incandescent and arc lamps has steadily increased year by year, not because of their cheapness, but because of their infinite superiority as illuminants over any gas flame yet developed.

Little Economies in Central-Station Practice.*

BY THOS. G. GRIER.

(*Continued from page 552.*)

Mast iron rope is being substituted for manila rope in a number of instances. Where live wire passes through trees one plant has fastened a wooden covering securely to the wire, thus saving the wire and the currents. Trees are a constant source of grounds, and tree insulation is a matter to be carefully considered.

Where the arc-light wires come to the small arm just over the head of an arc lamp and are fastened to the insulators the wire sometimes breaks. To prevent an open circuit from this cause an engineer in Wisconsin reinforces the wire at this point by joining a short piece of wire to the main wire several inches each side of the insulator, making a sort of a bridge or by-pass for the current.

A method for increasing the life of a pole is used in a plant in Illinois. A length of sewer pipe—the cheapest cull will answer—is slipped over the pole about to be set; after raising the pole adjust the pipe so that two inches of it will be above the surface of the ground, and fill in between the pipe and the pole with cement or grout. This keeps the moisture away from the pole. The pipe and cement cost about 25 cents per pole.

"The greatest saving known in the running of our plant has been through the introduction of meters," is the reply that came from a plant in Wisconsin.

Another says that close regulation or constant voltage saves many a lamp, and they save by guarding against irregularities in speed of machines and close attention to their instruments. Several plants considered the matter of regulation, one in which a saving could be made.

A rather large station says: "From 1 o'clock in the afternoon until late in the evening we keep a boy at a dynamo regulator on our incandescent dynamos in order to regulate the pressure on the lamps. We do not depend on the station instruments for this regulation, but have run pressure wires back from the centre of distribution of our different feeders and put indicators at the end of the pressure wires. The Edison three-wire systems do it also, but few alternating systems are carrying it out. By doing this we more than save the boy's salary in our saving in lamp renewals due to the pressure being kept regular during the heavy burning hours."

A station of 3500 horse-power recommend employing a machinist by the year as a Jack-of-all-trades. They have purchased a pair of belt clamps and outfit for $18, have sent one of their men to a belt manufacturer to learn how to splice belts, etc. They also sent a man to the T.-H. factory at Lynn to learn how to wind armatures. They purchased a Wheatstone bridge for testing, and are now doing all their repairs, from winding armatures and arc-lamp magnets, to taking up the slack in their 30 or more belts. They use a mechanical wattmeter, and find that a saving is made by having the meters cleaned, leveled up and tested, as they frequently run slow.

They insist on running but one service to a building for incandescent lights and incandescent arcs, and the customer consequently has his wiring done so that both these kinds of lights can be taken from one kind of service.

"On our system of 1000 volts primary and 54 volts secondary, where the heavy lighting is, we now run two No. 0000 wires the length of the block, and put a large transformer, either 150 or 300 light, on each pole, and tie the transformers together in multiple, thus displacing a number of small and insufficient transformers. The result is now not only economy in transformers, but ease in running services."

A humming converter means a loss of energy, and if there is a great deal of humming the converter should be examined to see if there are not some loose parts that need tightening. Rubber washers under the feet of a converter will deaden the noise, and perhaps quiet a kicking customer, which is economy. More economy is claimed for large transformers by the manufacturers.

The secretary of a successful station writes: "We have wattmeters on our 500-volt power circuit, on our dynamos supplying current to the street railway and our alternating incandescent circuits. We take the amperes of every arc circuit once each week and the voltage of every arc circuit once each night, putting down the time the arc circuits go on and the time they come off. In this way we know at the end of each month the number of kilowatts that we have manufactured and what portion each class of business bears to the whole

"Accounts which are common to all classes of business are prorated against each class, depending upon the output of the station in kilowatts. Other accounts which have a direct bearing on each business are chargeable to that business. In this way we know at the end of each month how much is chargeable to each business, and what are the margin of profits."

There are "little" economies "in details." Here are a few short quotations from letters I received "in response to my query as to little economies":

"The first to come to mind under your paper is discount all bills promptly, as your supply house can afford to give better prices when they know their invoices will be paid promptly."

"If furnishing street lights show your council and committee that you are trying to give the city all the contract calls for."

"Treat your customers as reasonably as possible; they will reciprocate."

"Collect all your bills before the 10th of the month."

"Keep the stockroom under lock and key and have supplies taken out on requisition; men get careless, and this is a leak that foots up very fast."

"Bad joints, that is, joints not soldered, and loose, are poor economy."

"The use of exhaust steam for heating in Winter is economy."

Every plant in itself is a distinct problem and what may be economy in one may not answer in another. This paper in noway covers the subject—it is simply a number of suggestions from men grappling with the problems of economy.

* Read before the Chicago Electrical Association, April 17, 1896.

Electrical Development in Japan.

A special commission has recently arrived in San Francisco authorized by the Japanese Government to study into the workings of electrical power and telephone systems in the United States. The commission is composed of S. Mine, R. Natayama and Y. Wadachi. They will be about two weeks examining into the telephone and electrical system of San Francisco, Sacramento, Fresno and other cities and will then proceed to Eastern cities. They expect to be absent from Japan six or seven months.

Commissioner Mine says that all over the Japanese Empire there is great interest in electrical power and in electrical lighting. Electricity has been introduced in several cities, but the Government wants it all over the country. It is the same way with telephones.

The Japanese want to generate electricity from the many powerful waterfalls in that country and use it for electric railways, general power and lighting.

It is their desire also to utilize the long-distance telephone in Japan. Mr. Natayama and Mr. Wadachi are experts on telephonic subjects.

Steam Boilers, their Equipment and Management.*

BY ALBERT A. CARY.

One of the first considerations to be taken up in designing a new boiler plant is found in the question, "What style of boiler is best adapted to our work?" and after this is answered the other question following closely at its heels is, "Are our available funds sufficient to equip this plant with the chosen form of boiler?" Unfortunately we find by no means a small percentage of prospective steam users asking these questions in the reverse order, and it is due largely to this fact that we find so many tank makers in the boiler business, so many coal companies flourishing and growing rich at the steam users' expense, so many boiler insurance companies springing up in every section of the country, to say nothing of the profits of the owner of the boiler, which unnecessarily go to keeping the boiler in repair and the coal pile replenished. All these troubles do not result from the doings of the "penny wise, pound foolish" man, but there is also a large percentage of the plants erected where ignorance has been the partner of the designer, and we find the outsiders again reaping the profits which properly belong to the victim.

Where the load fluctuations on the engine are excessive, the boiler must be of such design that it will deliver a very large quantity of steam in a very short space of time, and this may be accomplished in several ways, viz.: first, by having a boiler with an abnormally large steam space; second, by having a boiler with a large water capacity, and a moderate-sized steam capacity; third, by having large hot water storage cylinders to supplement the quantity of water held in the boiler; fourth, by running the boiler at a steam pressure several times higher than that used at the engine and delivering the steam through a very large reducing valve, which reduces and delivers the steam from the high pressure to the pressure required at the engine.

Each one of these methods has its own advantages and disadvantages, and the first one is probably the worst arrangement that could be made. In fact, it may be regarded as impracticable. An extremely large steam space is neither desirable nor necessary; it increases the size of the boiler unduly, as well as increasing the heat radiating surface. Our second method of caring for the very sudden demand for steam is by providing a large water capacity. Under these conditions a fall in pressure is depended upon to supply the steam required until the boiler is able to supply the demand continuously. With such an equipment when the throttle is suddenly opened, admitting steam to the engine, the steam from the steam space of the boiler first rushes into the cylinder, and we will say, for example, that the boiler pressure drops from 100 to 80 pounds. Let us next assume that we are drawing our steam from a plant of boilers holding 100,000 pounds of water. The temperature of the water under 80 pounds pressure, we know, is 323.9 degrees Fahr., while its temperature under 100 pounds pressure is 337.8 degrees Fahr. By turning to our steam tables we find the total heat in one pound of water under the above conditions, as follows:

One pound of water under 100 pounds of steam pressure contains 308.7 heat units.

One pound of water under 80 pounds of steam pressure contains 294.0 heat units.

Thus, when the pressure drops from 100 pounds to 80 pounds, the total heat required in each pound of water is less by 14.7 heat units. Multiplying this by 100,000, we have 1,470,000 heat units available for the generation of steam. Divide this by 886.7 (the number of heat units necessary to evaporate one pound of water at 323.9 degrees Fahr. into steam), and we find that we have 1658 pounds of water evaporated during the time of the reduction of the pressure from 100 pounds to 80 pounds. Now, if our engine uses 500 horse-power and 60 pounds of steam is required per hour per horse-power (equal to one pound of steam per minute per horse-power, or 500 pounds of steam per minute for 500 horse-power), we divide 500 into 1658; we see that from this lowering of temperature or pressure, we liberate sufficient heat to supply our engine with steam for about 3⅓ minutes, even though all other sources of heat are withdrawn, but this is not the case; the fire in the furnace will add its heat constantly at the same time, and thus we soon find an equilibrium established, and the boilers will finally be able to supply the engines steadily with the steam required.

Let us see how much of a boiler equipment we would need to cover the conditions we have just outlined. Let us suppose that we take horizontal tubular boilers 66 inches diameter and 18 feet long, containing 46 four-inch tubes. One boiler of this kind (allowing one third of the diameter vertically to measure the steam space) will hold about 14,000 pounds of water. Dividing this into the 100,000 pounds of water, we will find that it will require seven boilers, which, if rated by the regular builders' rating, would be sold as 668 horse-power. This is about one third in excess of the rated engine horse-power, but, considering the excessive duty called for in such service, it can be considered as a well-balanced plant.

The third method of providing for a great and very sudden demand for a large quantity of steam is accomplished, as has been stated, by providing one or more large hot water storage tanks which are used in connection with one or more regular boilers. The principle of working in this case being the accumulating of large quantities of heat in the water held in these tanks under pressure, to be called upon when needed, for steam-making purposes; a very similar principle to the storing of electricity in storage batteries, to be drawn upon at any instant when the current is needed. This is known as Halpin's system of thermal storage, and in the case under consideration its operation is almost identical to the second method just described, that is, it depends upon a fall in the steam pressure when the body of water gives up some of its heat which results in the formation of steam at a lower pressure. In this system, of course, a fewer number of boilers are used, but the quantity of water handled by these boilers is proportionally greater.

The arrangement of these thermal storage tanks in connection with the boilers is comparatively simple. The tanks are simply plain cylindrical boilers, but of course they must be capable of sustaining a pressure fully equal and generally much greater than the working boiler. The working boiler is run full of water, and is made to deliver a constant stream of hot water into the storage tanks, independent of the rate at which the steam is drawn from them, and for the best results this system should be run at at least 100 pounds pressure in excess to the pressure required at the engine.

We now come to the fourth method for supplying our sudden demand for steam, which was originated by the author. This is probably the most economical manner of solving this problem, first, as regards the original cost of the equipment, and secondly, as regards cost of operation. By this system the number of boilers required are reduced, the quantity of water needed is much less and this consequently lessens the amount of fuel required, and the consumption of steam at the engine is also reduced. Of course we will need, for this system, boilers which can be safely operated under high pressures and let us here (for the sake of comparison with the example we have given under our second system) suppose that we have in our new plant two water tube boilers each having a rating of 250 horse-power and running under 300 pounds' pressure, supplying steam to our 500-hp rolling-mill reversing-engine which is designed to work with 80 pounds' pressure.

In the first place, we will be obliged to place reducing valves in our steam main, between the boiler and engine. This will probably require more than one valve as there is too great a range in pressure between 300 pounds and 80 pounds to be successfully handled by a single valve. The object of these reducing valves is to receive the steam from the boiler at a pressure higher than that required at the engine and by means of throttling, reduce this higher pressure to the 80 pounds required. The fall in pressure at the boiler side of the valves may run all the way from the 300 pounds down to almost 80 pounds, but the pressure on the reduced side of the valves will always remain a constant 80 pounds. Steam at any higher pressure than 80 pounds will only cause a waste of steam at the engine on account of the high terminal pressure at the end of the stroke. This of course refers to our reversing engine, while with an automatic cut-off engine, too high an initial pressure will cause, toward the end of the stroke, the wasteful negative pressure which, on the indicator diagram, will be shown by the terminal loop. Returning to our rolling-mill engine, which is exhausted to the atmosphere, terminal pressure of course increases as the initial pressure is increased about 80 pounds. Thus it will be seen that reducing valves are a source of great economy in such practice. Those reducing valves must be very *large*, larger than required in ordinary practice.

As for the difference in expense in running boilers at a pressure of 300 pounds, instead of 100 pounds, it is hardly worth consideration. Practically speaking, a pound of coal will evaporate the same number of pounds of water into steam at any pressure. To show the truth of this statement, let us take a pound of steam at 100 pounds pressure, and again the same weight at 300 pounds pressure. The total heat in the first is 1185 heat units, while in the latter the

*Abstract of paper read before the Nineteenth Convention of the National Electric Light Association, New York, May 5, 6 and 7, 1896.

total heat is but 1209.3 heat units, a difference of only 24.3 heat units, and when we consider that our coal delivers between 13,000 and 15,000 heat units when burned, from 60 to 75 per cent. of which are utilized by the boiler in making steam, no difficulty can be had in comprehending our statement that practically the same amount of water can be evaporated per pound of coal, irrespective of the pressure. Now, in order to investigate the working possibilities of this arrangement, let us consider our plant somewhat in detail. Taking a well-known horizontal water tube, rated at 250 horse-power, we find that, under ordinary working conditions, it contains about 20,000 pounds of water. Two of these, making a battery of 500 horse-power, will, therefore, contain 40,000 pounds of water. As has already been stated, our 500-hp rolling-mill engine is designed to be operated with 80 pounds pressure. The steam space and steam liberating surface in these boilers are designed to be of sufficient size and capacity to secure dry steam when the boilers are supplying the maximum demand. It must be remembered that all sudden lowering in the pressure of boilers is followed by an increased ebullition of the water, which has a tendency to project particles of water into the steam space, and if ample space is not provided to allow most of these particles time to drop back again into the water from which they have risen, before the out-rushing steam carries them away into the steam pipes, trouble is very apt to follow if this moisture is not entrapped, or repeated from the steam before it reaches the engine. The exact steam liberating surface required in a boiler is pretty difficult to define, as experimenting in this direction has nor determined this with any precision, but it is safe to say that when steam is taken from the surface of water at a speed greater than 3 feet per second, water is generally carried with it. A curious fact has been noted in this matter, and that is, after steam once begins to pick up water as it leaves its surface in a boiler, it will continue to do so for a considerable time, even though the speed of its exit is considerably less than the speed at which it first began to pick up the water. The advantages of reduced steam space have been already discussed under our first system. Next, let us consider the amount of water required here, and compare it with the second system. Here we have 40,000 pounds in our boiler, while there we had 100,000 pounds.

One pound of water under 300 pounds steam pressure contains 391.9 heat units. One pound of water under 80 pounds steam pressure contains 294 heat units. The difference is 97.9 heat units. We thus find that a drop in pressure in our boiler from 300 to 80 pounds will render available, from each pound of water contained in the boiler, 97.9 heat units; therefore with 40,000 pounds of water we will have available 3,916,000 heat units to generate quickly the steam required. Dividing this by 886.7 (the number of heat units necessary to evaporate one pound of water into steam from the temperature of water under 80 pounds steam pressure), we find that we will have generated 4416 pounds of steam through this fall in pressure, and, as our engine requires 500 pounds of steam per minute, we find, by dividing, that we have a supply of steam which will supply our engine for 8.83 minutes, to say nothing of the steam generated directly by the fire during this interval. Thus you will plainly see that we have almost three times as much reserve energy available as in the second system, while we have but two fifths the amount of water. It is a well-known fact that water-tube boilers are very rapid steam makers, and in consequence of this, after dropping their pressure, as has just been stated, they will commence "picking up" immediately, and the nine minutes during which they are delivering steam from the available heat they have stored in the water under 300 pounds pressure is more than ample time for them to recover their maximum pressure again, and thus the desired result is accomplished.

To show where economy in operation occurs in this system there are many points which may be considered. In the first place, there is a lesser number of boilers required, which need a smaller boiler house, thus economizing room. Fewer boilers require fewer attendants. There is but 40 per cent. of water needed in this system that is necessary in the second one, and that means that it will require but 40 per cent. of the fuel, when starting the boiler, to raise the water from the temperature of the feed to the temperature of the steam, and it must be remembered that the amount of iron work and masonry to be heated and maintained at a working temperature is far less in this system than in any other.

If we have a single cylinder engine this lower pressure should be from 80 to 90 pounds, while with a compound engine, expanding its steam through two cylinders, 120 pounds has generally been found good practice. Passing steam through the reducing valve secures a most desirable result, aside from the mere reduction in pressure; that is, it either dries or superheats the steam delivered to the engine. A moment's reflection will assure us of this fact. We know that the total heat contained in one pound of saturated steam under 300 pounds pressure is 1209.3 heat units, and as there is practically no external work done by the steam when passing through the reducing valve, this pound of steam, although reduced to a lower pressure, must contain the same number of heat units. Dry saturated steam at 90 pounds pressure we find contains only 1182.9 heat units, thus we have (1209.3—1182.9) 26.4 heat units in excess of what is needed for dry steam. As dry steam requires but .48 of a heat unit to raise one pound one degree, we find that our reducing valve will raise the temperature of the steam at 90 pounds pressure, 55 degrees Fahr. above its normal temperature, providing the steam entering the reducing valve is dry. Should it, however, contain any moisture, this superheating effort will go toward evaporating the entrained moisture into steam. I have already described the operation of the high-pressure boilers working with their reducing valves, and now you will doubtless say, What saving can there be in fuel with this arrangement? In case our station has been working to its maximum limit and the load is suddenly diminished, the heavy fires carried, in order to supply steam enough for our crowded engines, will require some little time to burn down to the point needed to supply steam under our reduced conditions. Again, after operating the boilers to supply a light demand for steam and a heavy demand comes suddenly, how can our light fires be brought up quickly to the intensity needed to meet the new requirements? These apparent difficulties can easily be overcome by using a mechanical induced draft with a regulating device, which will vary the intensity of the draft to suit the requirements.

As every one knows, combustion in boiler practice is controlled by the amount of air passing through the grates. As the supply of air is diminished, the fire grows dull and finally, when it is shut off entirely, the fire smoulders and is soon extinguished. The regulated mechanical induced draft is constructed so as to control the air supply of the furnace and it works between wide limits of variation in a very short interval. This device is simply constructed by placing a fan, of the Sturtevant pressure type, in the flue between the boilers and the chimney. This fan is driven by means of belting; by a small steam engine working direct upon the driving shaft or by an electric motor. The speed of each of these driving devices is regulated by means of an attachment which is moved as the steam pressure varies in the boiler, very similar to the well-known action of the automatic damper regulator. This mechanically induced draft is not a patented device and so is open to all for use. In 1887 I designed and put into service the first mechanical induced draft system ever used in this country, and up to two years ago I believed this plant to be the first one of the kind ever built and operated, but at that time I was brought to realize the truth in the old saying, "there is no new thing under the sun," as I learned that a similar application of a fan for inducing a draft was invented and applied by Stevens in 1827.

Before closing this subject of regulated, mechanically induced draft, I would say that there are many electric light plants in which this system can be used to great advantage without the addition of the economizer, which will materially reduce the cost of installation. In some of these plants, we find the extreme maximum load lasting but two or three hours each day, and it will be merely during these times that the excessive temperature of flue gases exists.

After all, the matter of introducing any appliances to the steam plant resolves itself down to a simple commercial problem. Taking the matter of first cost and cost of installation, to which must be added the cost of maintenance, we can easily figure the interest on the investment. Next, after carefully considering the appliance, and securing, by personal investigation, the true results of other experience, you can determine with close approximation the real saving the appliance will make to the plant. Next, balance up and you will then be able to determine whether it is advisable for you to invest or not.

There is no doubt that a filter is an excellent addition to many boiler plants, saving many times its cost in a comparatively short time, but it certainly is not applicable to all plants, and a thorough knowledge of the existing conditions should determine its desirability. In England and Germany we find a method of purifying feed-water which is but little known in this country, and it is a question of no small moment for engineers to decide whether this process, which has proved so successful abroad, would not prove

equally valuable to our American plants, in which the character of the feed-water does not vary materially from that used on the other side. By this process large vertical tanks are placed near the boiler into which the cold feed-water is run. After it has been decided (by careful analysis) the kind and quantity of chemical or chemicals needed, these are introduced in amounts proportionate to the quantity of water used, and a precipitation follows the chemical combinations made in a similar manner to the action just described in connection with filtration, but in this process no filtering takes place. Inside the vertical tanks are found a series of shelves placed in an inclined position, and all sloping in the same direction. These shelves are often made V-shape instead of being flat, thus sliding their contents down to one particular point. Opposite this point a pipe will be found leading out of the shell of the tank and a straightway valve or cock opens or closes this pipe. This arrangement is found at the lowest point of each shelf, and all of the cocks are opened or closed at once by moving up or down a vertical rod. As the water flows from top to bottom of one of these tanks, the precipitation is thrown down on to these many shelves, finally sliding to their lowest points. As this sediment collects from time to time the vertical series of cocks are simultaneously opened, thus emptying all of the shelves of their deposited matter. By the time the water reaches the bottom of the tank, most of its dangerous impurities have been left behind, and so it enters the boiler in a desirable state of purity.

In this country we find the carbonates and sulphates of lime and magnesia in boiler feed-water successfully eliminated by the use of exhaust and live steam purifiers.

There are many other methods in use for purifying boiler feed-water; some are very effective while others have proved actually dangerous owing to the faith put in them by boiler users while they are supposed to be performing their duty, whereas really they are allowing scale to form in the boilers and owing to the security felt in their presence the usual care of the boiler ceases until trouble forces an investigation and then trouble generally begins.

There are many "compounds" and "boiler fluids" offered to steam users which, according to the sales agents, will cure every ill the boiler is heir to. These should be accepted only after careful advice with an expert chemist or with one who is well experienced in treating feed-water, as I have known many cases where their use has been attended with serious results. It is ridiculous to suppose that one special chemical or mixture will take care of every kind of boiler feed-water, as it is to imagine that any one medicine will cure every one of our personal ills.

Standard Rules for Electrical Construction and Operation.

The report of the committee of the National Electric Light Association on Standard Rules for Electrical Construction and Operation was presented by Chairman W. J. Hammer at the convention of that association on May 6.

The committee states that since the last report a large number of meetings have been held and its work actively prosecuted. The report embodied certain documents which had been prepared by the committee in furtherance of the objects of the association. The first of these was a copy of the preamble and resolutions adopted by the committee in September, 1895, which declare for standard rules, and provide a method of procedure with this object in view.

The committee then gave an account of the work done at the meeting in New York on March 18 and 19 last of the representatives of the various electrical and insurance interests concerned in the movement, and concludes its report in the following language:

"Your committee feel that there is every reason to believe that the long-sought-for, and much-to-be-desired end is near at hand, and that the formation of the national conference upon standard electrical rules will result in the near future in the adoption, promulgation and enforcement of one single recognized standard for electrical construction and operation; a standard code meeting fully the requirements and wishes of the electrical, insurance and allied interests of the country. Believing the interests of the National Electric Light Association will be conserved by the national conference, in which the association will doubtless continue its representation by an official delegate, your committee presents herewith its final report and beg to be discharged.

"Your committee most strongly urge the association to continue its representation in the national conference by the appointment at this meeting of an official delegate and the appropriation of a sum of money not to exceed $25 for carrying out the incidental expenses of the conference, other bodies contributing a like sum for this purpose."

On motion of Mr. Seely the report was accepted and the committee discharged.

Mr. Clay moved that the committee's recommendation as to the continuance of the association's representation in the national body be authorized.

This motion precipitated a lively discussion.

Judge Armstrong opposed the motion. He had the most serious objection to the National Electric Light Association being represented by one or more men in any other association, national or international. The association was absolutely independent, standing for a certain purpose, able by its constitution and organization to cover the whole field, and bound not at all by any other body whatever. He did not see how under the constitution the committee's suggestion could be adopted.

Mr. Ayer thought Judge Armstrong did not fully comprehend the situation. He did not think the association would lose its individuality by being represented in the national body, but would be gaining a strong point. "We are here," he said, "to accomplish the one object—the advancing of the electrical interests," and he knew no better way to secure a broad step ahead than to ensure the permanency of the organization as outlined. He favored the motion.

Mr. Hammer at this point explained that the association would not be committed in any way by the proposed delegate. The adoption of the code prepared by the national body will be optional with the associations and bodies represented therein.

Judge Armstrong insisted, on conditional grounds, that the committee's recommendation was inadvisable. He was entirely in harmony with the object of the recommendation, "but do not, for heaven's sake," he said, "let us do it in this way, unless we want to make trouble for ourselves in the future."

The discussion was finally closed by the adoption of a substitute to Mr. Clay's resolution, which substitute was offered by Judge Armstrong as meeting the situation, that a committee of five be appointed on standard electrical rules, which committee may designate some one to confer with the representatives of other bodies on the same subject, with power to expend not to exceed $25 annually.

Diagnosticating Disease with Röntgen Rays.

To the Editor of The Electrical World:

SIR:—On April 22 and 23 I succeeded in applying the X-rays to the diagnosis of disease in such a manner as to convince me that there is a large field of usefulness for the X-ray in this direction.

I found it possible to cause a screen of calcium tungstate paper to fluoresce powerfully even though the body of my assistant be interposed between the tube and the screen. It became evident at once that the entire skeleton could be distinctly made out by the shadows cast on the tungstate screen, even the skull being clearly shown. The cartilaginous laminæ between the vertebræ could be distinguished. The heart could be seen in faint outline and its pulsations faintly seen. The lungs are very transparent. The liver is very opaque and its rise and fall with the diaphragm can be plainly followed.

I was able, with Dr. Francis H. Williams, to examine several patients from the City Hospital, to see how an X-ray diagnosis would agree with that previously made by the hospital staff. The outline of an enlarged liver, seven inches in diameter, could be easily distinguished, the two outlines, one by percussion, and one by the X-ray, agreeing to better than one-half an inch. An enlarged spleen could be detected and outlined perfectly. A case of tuberculosis of one lung with the other lung sound, showed the sound lung transparent and the diseased lung almost as opaque as the ribs.

The cleared portions of the lungs of a convalescent pneumonia patient could be plainly seen, and were as was indicated by percussion.

A buckle, or small pellet of lead, is easily detected through any part of the body except the lower part of the abdomen, and hooks and eyes are easily seen through the more transparent parts.

It will appear at once that no careful diagnosis can be made through ordinary clothing, the hem on a shirt front being about as opaque as a rib.

No difficulty was experienced in finding a musket ball in the arm of a man, the bullet having broken the ulna and embedded itself in the radius about three inches further up the arm. The bullet was found exactly under the spot which we marked as being over the bullet.

We have taken photographs in one-fifth of a second, but have rather discarded the method of photographing because the eye can detect on the fluorescent screen what the sensitive plate takes much longer time to record. The skull is not opaque, but of course no notion of the texture of the brain can be obtained. The detail of the lower jaw, the teeth and so on can be clearly made out. The æsophagus is quite transparent and a foreign metallic body can hardly fail of detection if in the upper part of it.

The cartilaginous rings in the trachea, the glottis and the epiglottis can be seen fairly well.

Younger persons are more transparent than older, but show less differentiation, even the bones being quite transparent in a boy of ten years.

Boston, Mass. Chas. L. Norton.

Attix Wire and the Board of Fire Underwriters.

To the Editor of The Electrical World:

Sir:—The Attix wire and I have been the subjects of numerous and severe criticisms. Mr. Edward H. Johnson, the enthusiastic proprietor of the iron armored conduit, has repeatedly stuck his sharp pen into me, intimating that I know little or nothing about the subject of electricity.

I shall not impose upon the good nature of those who do me the favor to read this, my first communication upon an important subject, with any defense of myself. I desire, at this time, simply to call attention to what is infinitely more important than my knowledge or ignorance, viz.: The existing situation with regard to electrical conductors and their installation.

At present the following systems are allowed by the rules of the various associations throughout the country, including the Electrical Bureau of the New York Fire Department.

First: The so-called circular loom tube. This is not waterproof, a serious objection; it is combustible; it is not nail-proof; it is not calculated to resist crushing strains; it is admitted that it will rapidly deteriorate by the action of cement when embedded in the same.

Second: The brass armored conduit. This is also objectionable, and is little, if any, better than the circular loom tubing. It will not withstand nails, and several fires have been traced to its use where it has been exposed to moisture, or where the interior portion of the tubing has become broken, the outer metal covering becoming the conductor.

Third: Braided wire. This is also allowed. It is, of course, not fireproof or nail-proof, and is permitted, provided only that it be supported on non-combustible insulators constructed so as to prevent the insulating covering of the wire from coming in contact with other substances than the insulating supports, and provided also the two wires are kept apart a prescribed distance.

Fourth: The so-called Johnson tube, which Mr. Johnson himself admits, in the "Electrical Bulletin" of March last, is "simple gas pipe and asphaltic paper tube as a lining." This iron pipe is of course nail-proof (an important feature), and if free from burrs and properly reamed where junctions are made (precautions not always taken) it is not liable to injure a conductor while being drawn through it. Its chief claim for merit lies in the simple "gas pipe" feature. The paper insulation lining itself, however, is susceptible to damage from moisture (and condensation is a feature of all metal pipes) and is liable to be turned into pulp and push up as the conductors are pulled through with the force incident to the process.

Moreover, examination of the insulation cannot be made when the tube is being installed, to see whether it is perfect throughout its entire length. This seems to me an important and vital objection to all insulation which is attached to the interior of tubes. In this important respect it is vastly inferior to an insulation and waterproof covering like that of the Attix wire, which can be examined for every foot of its length before being installed. It is not necessary to explain that if a metal tube is imperfect as regards insulation, the tube itself may become a conductor.

There are several other so-called insulated metal pipes, or conduits, but I believe none of them is better than the Johnson tube.

Now, the so-called rules of the different associations, which are construed literally by all the exponents of the Johnson iron-armored conduit and by all of the exponents of the Attix wire, recognize as permissible the different appliances I have described. To a man up a tree, who does not claim to be an expert, but who has simply climbed up to take a look at things, this situation seems very inconsistent—not to say ridiculous. There is a wide range of safety between the ordinary braided wire and the Johnson iron-armored conduit, in fact, no one can doubt that all of these various appliances differ vitally as to safety, although treated by the rules as equal in safety; nor can any one doubt, it seems to me, that the Attix wire is superior to some of them, if not to all of them.

I believe that the Attix wire, which consists of the Habirshaw wire with pure para rubber insulation (no one will, I think, claim that a better wire is made than Prof. Habirshaw's) protected by the Attix wire covering, is more thoroughly waterproof under all conditions than any other wire covering. This I state on the testimony of numerous capable experts. It has been opposed, first, because it is not a conduit or raceway; and second, because it is not installed on porcelain insulators and bushed where it passes through wooden beams. Those who oppose it on the ground that it is not a conduit, overlook the fact that a conduit or raceway is a mechanical feature for convenience of removing a conductor and is not a requisite as to fire protection. A nail-resisting conduit, however, is an advantage, and it seems to me that the ideal situation would be reached from the viewpoint of present knowledge on the subject, if the Attix wire should be introduced through a simple iron gas pipe, carefully cleared of all burrs, etc.

I believe that it would be preferable to the Johnson tube, in that the wire could be examined for every foot of its length before installation, an important precaution, which is not possible with the Johnson tube. It would be proof against moisture and would not depend for continuity of insulation on the workmen installing the system, as is the case with wires in conduits. Indeed Mr. Johnson himself, made the following statement at a meeting held some time since: "Inasmuch as it is pretty well decided that the Attix wire, with our old friend Habirshaw's insulation, is certainly an advance; put that inside of the conduit where its advantages can be had." (I have done Mr. Johnson the justice to quote his exact language from the stenographic report.)

No insulation which is attached to the interior of a tube ought to be regarded as the equal of the same quality of insulation on the wire itself, because examination when the conductor is being installed is important and necessary.

These ultra-technical experts who oppose the Attix wire and quote the literal phraseology of the rules, would condemn an ideal installation if one should be discovered to-day; a flexible tube of malleable glass, irrefragable and non-penetrable would be condemned under the present rules, because it would not be an insulated tube.

I believe that time will determine that the action of the Committee of the New York Board of Fire Underwriters is in line with safe practice, and that the present opposition to the Attix wire, especially when enclosed in a plain iron tube, is unjust and in the interest of various patentees. If the Johnson tube is good, the Attix wire in a plain iron tube is better. F. C. Moore.

New York City.

What Mr. Johnson Has to Say on the Subject.

To the Editor of The Electrical World:

Sir:—Replying to Mr. Moore's rather remarkable communication on the subject of electric wiring. I am not aware of having paid my respects to Mr. Moore personally, "sharp" or otherwise. He must be appropriating to himself some criticism of the ideas he represents or some impersonal comment of mine upon the integrity and intelligence of their advocates; but let that pass; personalities are neither interesting nor helpful. I am at one with Mr. Moore in his remarks on circular loom. I am not even disposed to take violent exception to what he says as to the deficiencies of my brass-armored tubing, although there is plenty of room for doing so. As to braided wire I am in accord with him, only remarking, in parenthesis, that his—I mean Attix—wire comes painfully near inclusion in this category. But these are non-essentials and may be passed by mere casual reference, so that we may promptly come to the real bone of contention, viz.: The iron-armored tube, that invincible champion of protection which bars the way to free trade in Mo(o)re Attix.

My admission that the iron armor of my conduit is simply gas-pipe is thrust forward as though a concession—a concession to what? Is gas-pipe not an all-sufficient article for the purpose? Or is his remark a covert suggestion that I am trying to palm off common everyday gas-pipe as an article possessing some peculiar electrical attribute? If neither of these is meant, what is the bearing or point of the "admission"? "Its chief claim for merit lies in the simple gas-pipe feature!" Who says so? Why, Moore, of course, not Johnson, or the facts they say its chief claim is its insulated lining, and that the protection afforded by the armor is subordinate and incidental.

Mr. Moore asserts on his own unsupported authority that this lining is liable to be turned into pulp and to push up as the conductors are pulled through. I have been selling this tube for five years—a million and more feet a month. That complaint is new and clearly original with Mr. Moore—evidently a bit of special pleading to make his case.

"Examination of the insulation cannot be made when the tube is being installed!" What necessity for examination, or if necessary, why impossible? A 10-foot tube clear and clean as a gun barrel cannot be traversed by the eye? That's novel. If, perchance, he means the eye cannot detect defects in the insulation, then I reply, no more can it detect defects in the insulation of the wire. The eye is not a voltmeter.

"It is not necessary to explain that if a metal tube is imperfect as regards insulation, the tube itself may become a conductor."

It required no metal X-rays to discover that if the metal of an insulated tube is liable to become a conductor by an impairment of its insulation, it is certain to do so, if the tube be minus all insulation.

With what Mr. Moore says as to the inconsistencies of the rules in permitting practices which are inferior and then illogically endeavoring to provide by rule for their correction, I am in entire accord, merely remarking that his argument is an apt indictment of his every step in this Attix-wire matter.

Mr. Moore's assertion that a conduit or raceway is a mere mechanical convenience "for removing a conductor" and is not a requisite as to fire protection, is made upon the assumption that there is no virtue in the insulated lining, and moreover utterly overlooks the reasons for "removing a conductor." The fact is the necessity for such removal often arises from the impairment of the insulation of the wire, or from a break in the wire itself. In either case, electrical disturbances capable of mischief are present. The existence of the extra insulation in the tube confines these disturbances to the interior; its absence would permit them to appear externally, and consequently to be transmitted to indefinite and unknown conditions of inflammability. This, in fact, is the essence of the controversy between insulated and non-insulated raceways and it cannot be disposed of by dogmatic assertions even though voiced by presumptive authority.

"I believe that it would be preferable to the Johnson tube in that the wire could be examined for every foot of its length before installation—an important precaution which is not possible with the Johnson tube," etc., etc.

This is novel reasoning. Will some one tell me *why* it is not possible to examine the insulation on an Attix or any other wire when placing it in an insulated tube? What is the differentiating property of an insulated tube that renders the eye incapable of performing its ordinary function? Is it that the Attix eye suffers from acute strabismus when so employed?

Mr. Moore says the Attix wire drawn into plain gas-pipe would be proof against moisture: Where and when was the discovery made of an insulation that was proof against the effects of alternate moisture and dryness? And where and when was the discovery made that an open metal pipe was proof against the trick of evolving these alternate conditions from the atmosphere contained within it?

Mr. Moore quotes me as endorsing the Attix wire as an "advance" and as suggesting that it be "placed in a conduit where its advantages can be had." He does this in support of his contention that a plain iron pipe, not my insulated article, is a conduit and apparently calls me in to confirm his deductions, and then drives the nail home and clinches it with the remark that he has done me the justice to quote my exact language. If this little by-play is a measure of the gentleman's honesty, it is, perhaps, not unfair to ask the reader to carefully weigh his assertions in other respects.

Ultra-technical experts "would not call a glass tube an insulated tube." Why not? What would they call it—however ultra? As to time determining that the action of the Committee of the New York Board of Fire Underwriters is in line with safe practice, it would seem to me that, considering the special function of that board, such determination should not be left to time or be at all conjectural, but, on the contrary, should be so instantly apparent as to afford no possible ground for questioning its wisdom. In short, Mr. Editor, is it not somewhat of an anomaly to find the promoters of a new industry standing as the exponents of rigorous rules and regulations, as against the disposition of official authority to weaken them, and thus open the door to insecurity? And yet this is precisely what Mr. Moore and his coadjutors are doing. If insulation is something which we must need carefully safeguard, official authority should not object to the multiplication of safeguards, even though interested parties solicit them to do so.

Is there not some explanation of the open and undisguised partisanship in this Attix matter on the part of the president of an insurance company less illogical than the advocacy of a reduction of safeguards?

EDWARD H. JOHNSON.

Among the Exhibitors at the Electrical Exposition.

Last week we devoted considerable space to descriptions of exhibits at the Electrical Exposition; in this issue attention is given to some which were unavoidably omitted last week. We also give this week several excellent illustrations of exhibits described in our last issue.

THE UNITED ELECTRIC IMPROVEMENT COMPANY'S exhibit, which was described last week, is illustrated herewith. The 750-light alternator attracts the attention of electric light people. The feature of the company's system is the absence of transformers.

EXHIBIT OF THE UNITED ELECTRIC IMPROVEMENT COMPANY.

THE BIRDSALL MANUFACTURING COMPANY'S exhibit attracted much attention through its entire novelty of character. It enjoys the distinction of being the only one of its kind in the Exposition. Electric cigar lighters, electric flower beds, electrically illuminated clocks, signs, etc., constituted this unique display. The night clock enables a person in bed to ascertain the time by pressing a button which lights a lamp in front of the clock face. The cigar lighters are attractive to smokers, and the ladies admire the prettily illuminated flowers in the jardinieres.

EXHIBIT OF THE BIRDSALL ELECTRIC MANUFACTURING COMPANY.

Mr. W. S. MCGOWAN, secretary of the Ball Bearings Company, Boston, is making many friends at the Exposition.

The National Photograph Machine Company, New York, exhibits a slot machine, and takes a large number of photographs daily.

The John Simonds Manufacturing Company, New York, has a fine display of valves and steam fittings and also a large pipe threader de-

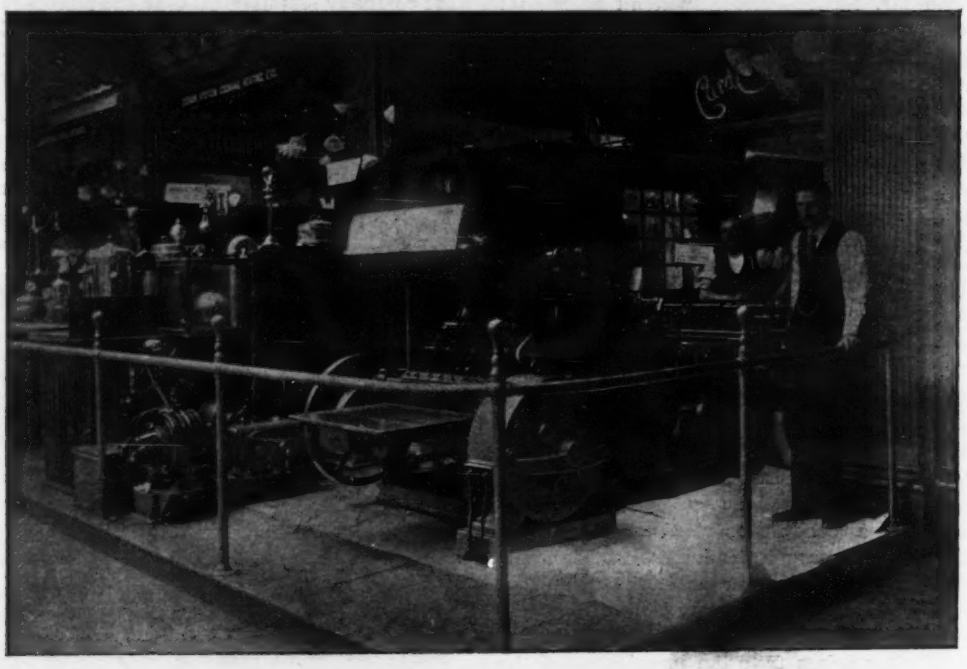


Exhibit of the Card Motor & Dynamo Company.

signed to be both rapid and efficient in its working. This exhibit is one of much use and interest to all who have to do with steam plants.

Exhibit of the Borne-Scrymser Company.

The Card Motor & Dynamo Company, Cincinnati, O., shows in a practical way some of the uses of its motor. One of these machines is direct-connected to a Hoe stop cylinder press. It runs as low as 80 revolutions a minute and as high as 120, there being five changes of speed within these limits. All of the printing of the National Electrical Exposition is done on this press. The current for the operation of the motor is supplied by the Edison Illuminating Company. This exhibit is intended as an example of the application of the Card slow-speed motor for direct connection. The Card Company is said to be the pioneer in this branch of electrical application, and has installed a large number of direct-connected machines.

Mr. J. T. Hamby, general manager of the Beacon Lamp Company, Boston, was a visitor at the Exposition last week and expressed himself well satisfied with the show. Mr. Hamby is paying considerable attention to Crookes tubes, and claims that the Beacon company makes one of the best tubes on the market.

The E. G. Bernard Company, Troy, N. Y., distributed a very attractive and popular souvenir at the Exposition in the shape of a box of cigarettes made of the most expensive imported Turkish tobacco, and whose delicious flavor was highly appreciated by those of the electrical fraternity who were fortunate enough to secure them.

The C. W. Hunt Company, New York, exhibits only its conveyers in action, arranged to carry coal to the generating plant of the Abendroth & Root exhibit. Its driving gear, including a non-freezable engine, is in full operation and the practical application of the company's system embodied in its exhibit makes it of more than usual interest.

Mr. Albert Van Suan is exhibiting a specialty in electrical signs. A transparent sign has revolved behind it a number of glass tubes filled with broken glass of various colors and illuminated by electric lights. When this belt of glass tubes revolves an iridescent effect is produced on the letters of the sign.

The Lewis Tool Company, manufacturers of vises, New York, is showing a new adjustable jaw and a bicycle vise; also a full line of vises from 1¾ to 222 pounds. This company makes 64 different styles of vises. The exhibit is in charge of Mr. G. Lewis, assisted by Mr. J. B. Cary.

The Borne-Scrymser Company, New York, manufacturer of lubricants, has an attractive exhibit which is well shown in an accompanying illustration. The arrangement and decoration of the booth was very tastefully attended to, and an artistic disposition of electric lights made the display particularly attractive at night. The principal features of this exhibit were described in the last issue of The Electrical World.

The Crane Company, Chicago, exhibits a line of high-pressure valves and large valves with by-passes and similar necessary adjuncts to steam

installations. The company's goods are well known and standard, and its exhibits are always interesting and attractive, this one being no exception.

THE CLONBROCK STEAM BOILER WORKS, Brooklyn, N. Y., has a booth located on the second balcony and exhibits parts of the Morrin Climax boiler and also a little 10-hp boiler, together with photographs and blue prints of its systems. Mr. John A. Mason entertains visitors and explains.

THE J. G. BRILL COMPANY, Philadelphia, exhibits in its space one of its improved trucks with new spring suspension from the axles and all of the latest features. This truck is a familiar object among the engineering fraternity, but nevertheless is a source of considerable interest to many visitors.

QUEEN & CO., Philadelphia, exhibit a large number of instruments taken from their stock, most of which are familiar and are standard. Particular interest centres in the new photometer invented by Messrs. Houston & Kennelly, and adapted to measure the mean spherical candle-power of lamps.

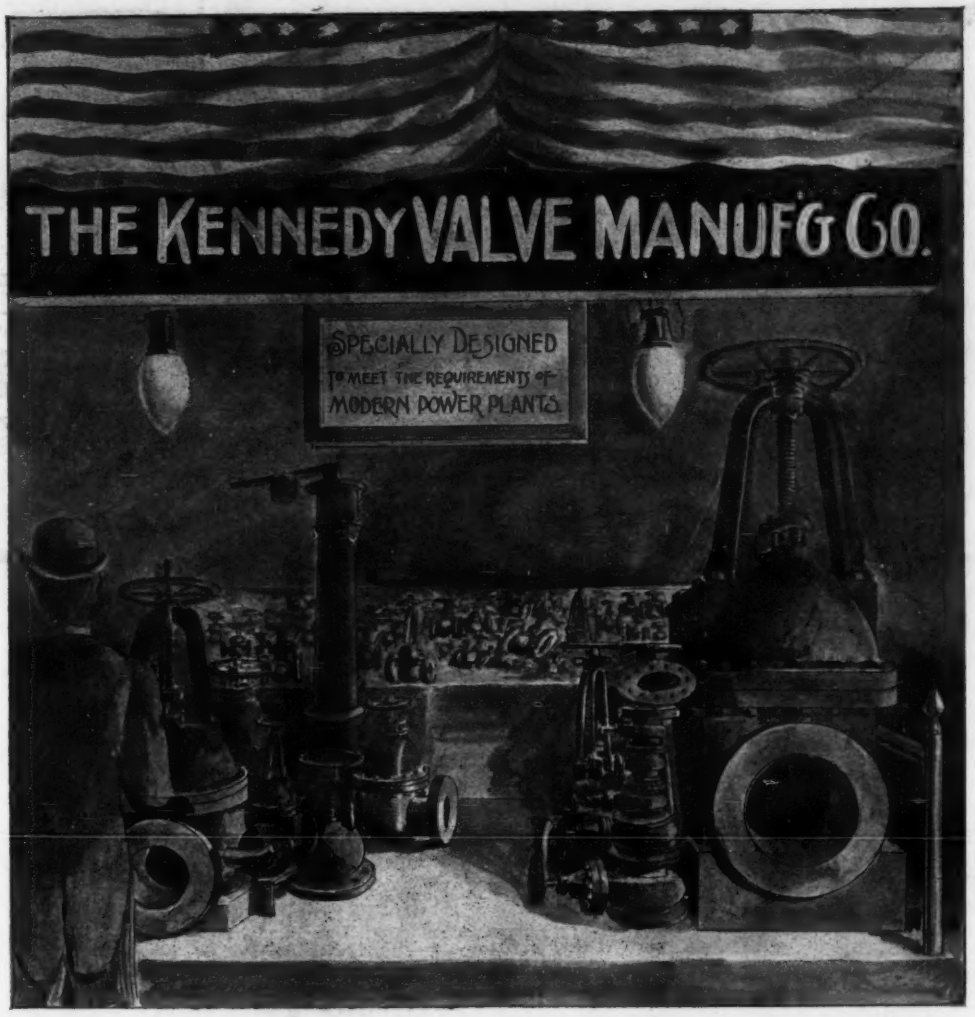


EXHIBIT OF THE KENNEDY VALVE MANUFACTURING COMPANY.

THE KENNEDY VALVE EXHIBIT is shown in an accompanying illustration. The exhibit, as was described in last issue, consists of a full line of the various styles of valves made by the Kennedy Valve Manufacturing Company, New York. The valve lock attachment was shown here for the first time. The Exposition boiler plant is furnished with small Kennedy valves.

THE SHULTZ BELTING COMPANY exhibit is illustrated in one of the accompanying cuts. The Shultz Company's space is on the ground floor, and the exhibit was described in the last issue of THE ELECTRICAL WORLD. This company's belts of all sizes are shown in the most effective manner possible, and the miniature representation of the company's trade-mark—an actual working model—attracts much attention. All interested in belting find at this exhibit something to engage their earnest attention. Mr. A. B. Laurence, the New York manager, is on hand most of the time, with his assistants.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY'S exhibit which was described last week, is illustrated on the next page. It is one of the first seen on entering the main hall, and faces the centre of the auditorium. The features of this exhibit, which is shared in by the local Westinghouse sub-company, the United Electric & Power Company, are

THE GORDON-BURNHAM BATTERY COMPANY, New York, has an attractive exhibit of its celebrated batteries, which was described in last issue. The accompanying illustration gives an excellent view of the Gordon-Burnham Company's booth, which is attractively and artistically

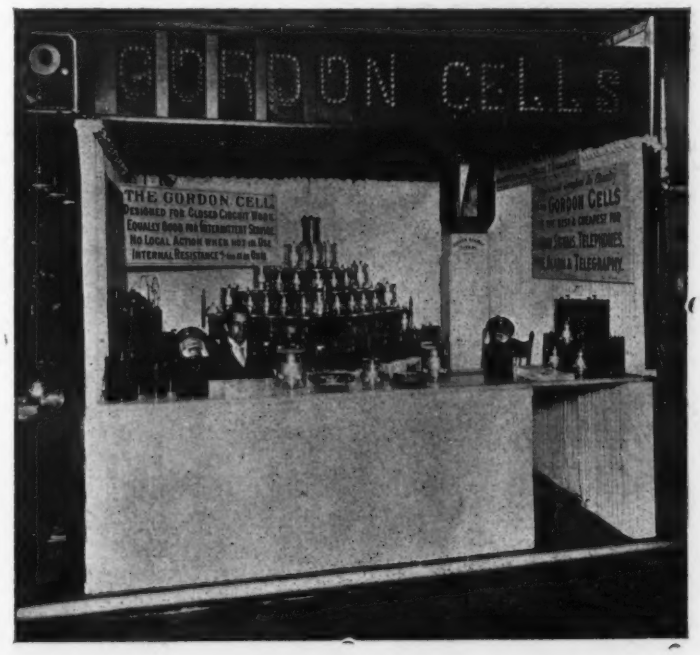


EXHIBIT OF THE GORDON-BURNHAM BATTERY COMPANY.

EXHIBIT OF THE SHULTZ BELTING COMPANY.

decorated. The batteries are shown to the best possible advantage, and their use is practically demonstrated at the exhibit. This battery is equally good for open or closed circuit work and gives a large current.

two-phase motors and single-phase, self-starting synchronous motors. Sawyer-Man lamps attract the attention of the interested visitor, and various converters are also shown. The practical illustration given at

this exhibit of electric lighting by induction mystifies the uninitiated, and the spinning steel egg and top are never-ceasing wonders.

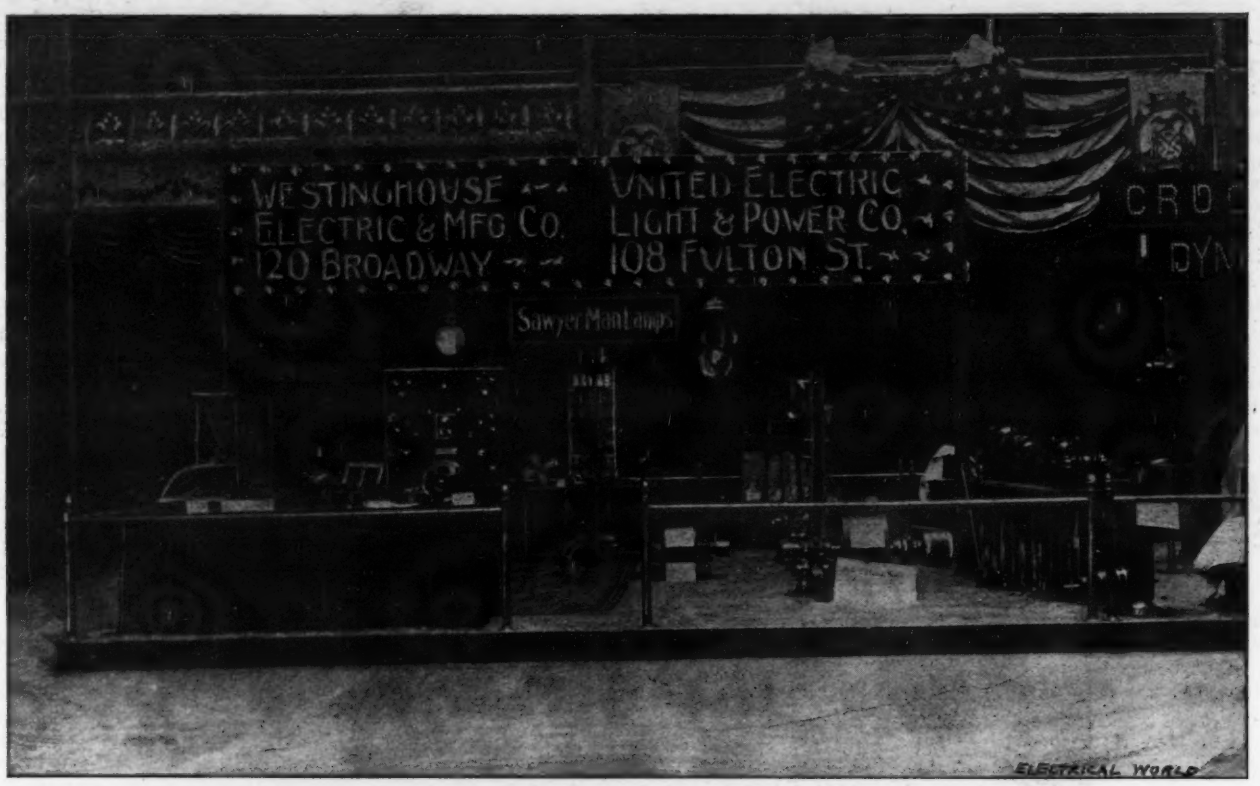


Exhibit of the Westinghouse Electric & Manufacturing Company.

The Brush Electric Company's excellent exhibit was fully described in the last issue of The Electrical World. We give herewith an illustration of the same. The exhibit is on the ground floor and has many attractive features. From the ceiling hang 80 Brush arc lamps, and on the floor are shown various Brush generators, among them the first Brush dynamo which was made in 1877. The Brush 80-light 2000-cp multi-circuit arc dynamo is, of course, the feature of the modern exhibit. In the illustration it is shown at the right. The historical portion of the exhibit attracted much attention. The 1877 dynamo referred to did duty for 12 years and is apparently good for as many more. In the planning and arrangement of this exhibit some excellent work was done by Mr. Herman J. Douds.

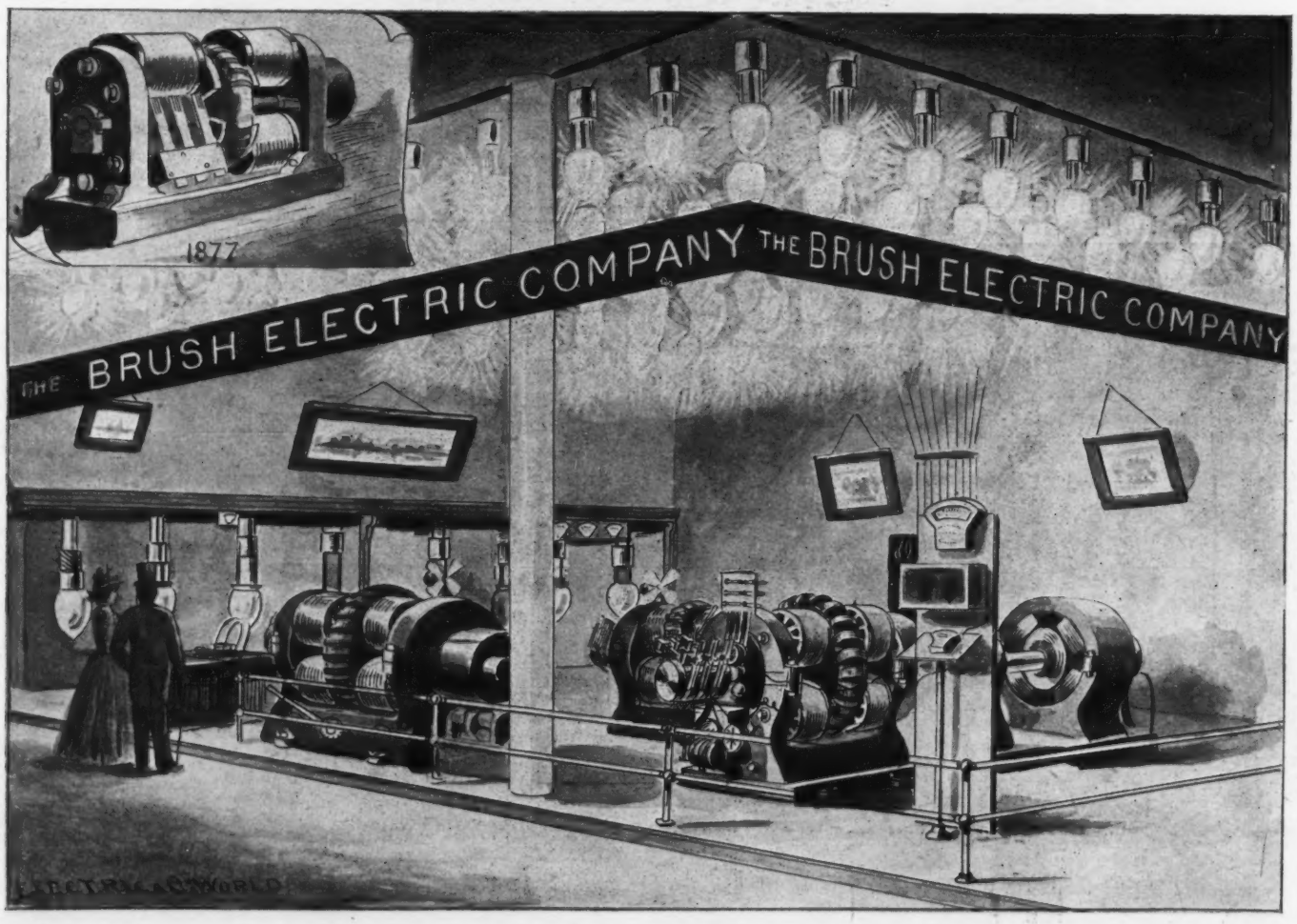


Exhibit of the Brush Electric Company.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY, Philadelphia, has an attractive exhibit on the main floor, under the gallery, which was described last week. This week we give an illustration of this interesting

EXHIBIT OF THE CUTTER ELECTRICAL & MANUFACTURING COMPANY.

exhibit, which includes a fine line of flush-switches, circuit-breakers, etc. The I. T. E. circuit-breaker is the chief attraction, and its sensitiveness and reliability of action command the admiration of all interested.

THE BOYNTON MULTIVOLT BATTERY COMPANY, manufacturers of primary batteries, New York, is exhibiting a five-volt cell, the cell being 6 x 8 inches. A feature of this exhibit is the operation of six eight-inch, four-blade fans by one cell; and the lighting of an eight-cp incandescent lamp from two cells. The company is represented by Mr. C. H. Brigham.

THE VARLEY DUPLEX MAGNET COMPANY, New York, exhibits various magnets wound by its system, using one bare and one insulated wire. By this means a bobbin may be wound for 5 per cent. less resistance, 5 per cent. more turns and 40 per cent. cheaper, in sizes from No. 24 and finer. Messrs. W. J. Varley, Richard Varley and J. B. Farrington are in attendance.

THE H. C. JONES ELECTRIC & MANUFACTURING COMPANY exhibits a double-pole switch and a receptacle which are absolutely non-short-circuitable, and are intended to be used for stage purposes. These switches are inserted in the bottom of a tray and water is poured freely over and through them without in the least affecting them, whether they be open or closed.

GEORGE P. HALL & SONS, New York, have a fine exhibit of remarkably difficult photographs, especially those of prominent high buildings of New York.

THE WALKER COMPANY, Cleveland, O., has combined with the Phœnix Iron Works Company in a generating exhibit of much interest. A tandem-compound Dick & Church engine drives a Walker generator capable of

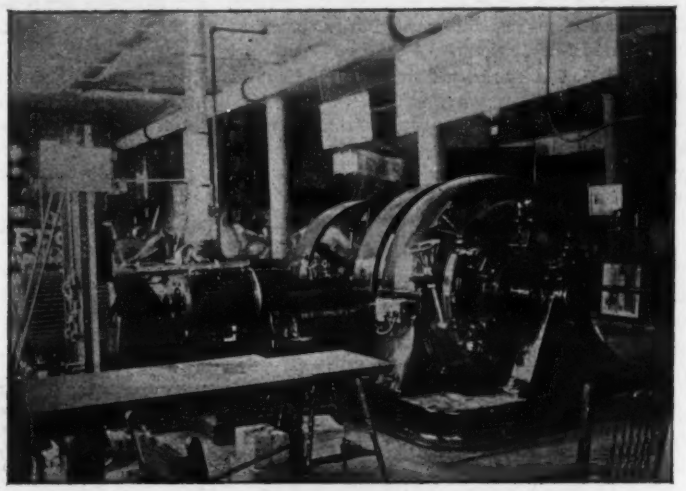


EXHIBIT OF THE WALKER COMPANY.

producing 640 amperes at 115 volts. A new brush holder arranged both to feed the brush and to give it firm contact against the holder is quite interesting. The brush can be readily removed with the fingers, but at the same time bears firmly and evenly on the commutator. The machine is operating sparklessly and quietly, and produces a favorable impression.

EXHIBIT OF THE PERU ELECTRIC MANUFACTURING COMPANY.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., has a unique exhibit. The sides and back of the booth are covered with a profusion of batteries, carbon and porcelain goods, arranged in tasteful designs. Laclede-Hercules open-circuit batteries form a prominent feature of the exhibit, and among the various other goods shown are porcelain cut-outs and insulators for electric-light wiring.

J. B. COLT & CO., New York, have a fine display of projector lamps and lenses, some of which are in actual operation. They utilize them to project X-ray slides upon a ground glass screen. They have a fine assortment of these slides and the exhibit attracts much attention. Mr. A. B. Patten is in charge.

THE FIBERITE COMPANY, Mechanicville, N. Y., has gone into a new branch of manufacture—that of switches, both quick-break and of the ordinary jack-knife pattern. The company exhibits a board covered with samples of its new goods which is attractive and the source of much favorable comment.

THE TAUNTON LOCOMOTIVE WORKS, Taunton, Mass., is exhibiting its steam fittings and corrugated tube feed water heater, well known as the Wainwright heater. The company also exhibits copper gaskets and its

triple expansion joint. One joint will carry 40 feet of pipe. Mr. B. Hayes is in attendance.

Mr. W. J. Morrison, formerly New York State agent of the Fort Wayne Electric Corporation, and now associated with the Ball Electric Light Company, of New York, has evidently lost none of his popularity. He is kept busy at the Exposition greeting old friends. Mr. Morrison has some nice testimonials regarding the Ball apparatus, which he never fails to show interested visitors.

Mr. H. H. Eldred is exhibiting the Eclipse bicycle lamp, made by the Eclipse Electric Company, Buffalo, N. Y. This lamp is arranged to run with an electric battery for four hours at one charging. By inverting the lamp the fluid in the cell falls away from the elements, thus stopping the generation of current. The cell is mounted on a pivot and, therefore, readily turned either side up.

The Riker Electric Motor Company, Brooklyn, N. Y., exhibits a 5-kw Riker dynamo connected to a Case engine of appropriate capacity. The whole unit is very compact and very small for its output, and being well made, is remarkably attractive. The exhibit of fan motors and a handsome switchboard are a source of added interest. Mr. James P. Lough represents the company.

The United States Prism Glass Globe Company's exhibit in the gallery is a glow of light at night. The various prism glass globes that depend from the ceiling of the booth and those otherwise disposed about the stall, scatter the light in prismatic rays, and make the exhibit a very attractive one. The globes are of various colors, and the diffusion of the light is a pleasing feature of the display.

Mr. F. B. Holt is exhibiting an interesting slip joint in steam pipes, which is now in use on many of the warships of the United States. A brass tube is covered with asbestos packing, and when heated effectually seals but does not bind the cylinder, which slips within it. A number of ingenious diffusing globes made of glass tubes containing brass rods makes the exhibit brilliantly attractive.

The Gold Electric Car Heaters are exhibited in a tastefully decorated booth, which is presided over by Mr. J. Ward and Miss Harriet Becker. Heaters are shown designed for both street car and house use. The heaters for domestic use are specially ventilated to allow the rapid diffusion of heat into the atmosphere of the room, and thus insure the whole being maintained at an even temperature.

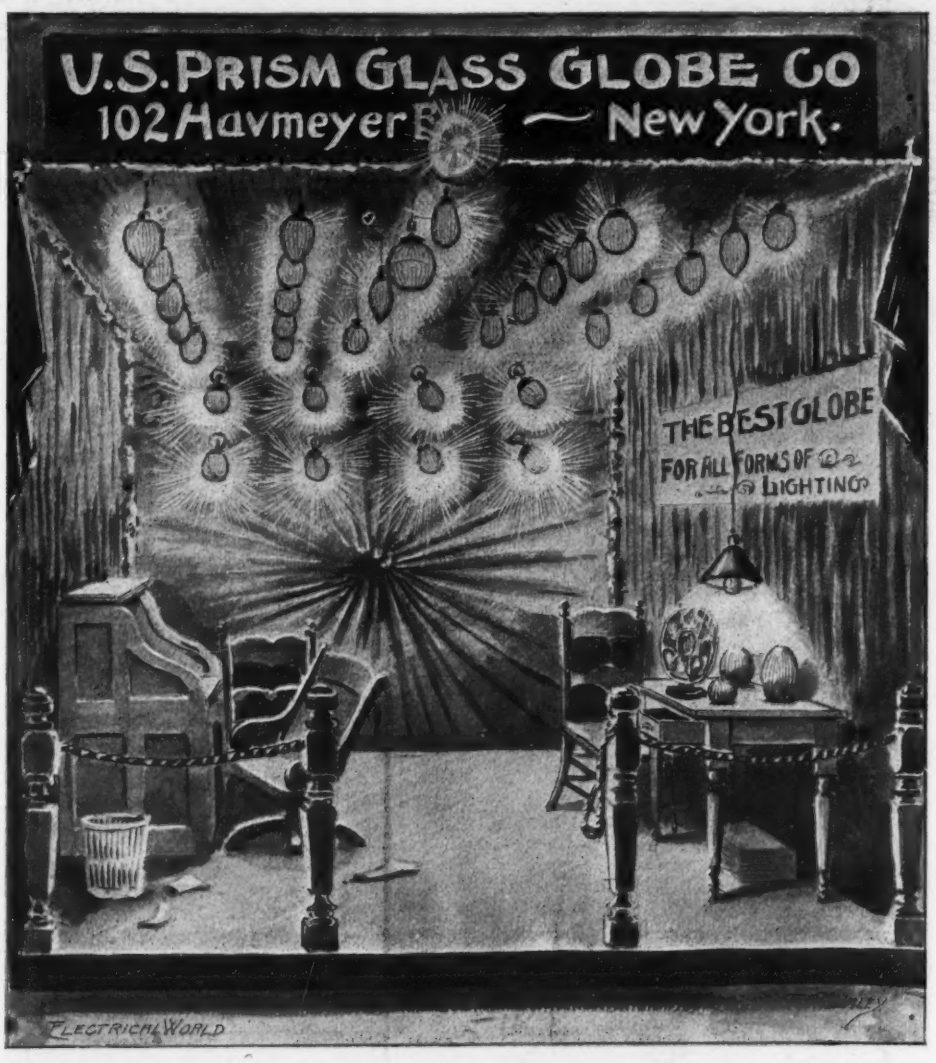


Exhibit of the U. S. Prism Glass Globe Company.

The Ironclad Rheostat Company, Westfield, N. J., engaged 100 feet of space at the Exposition, but, we are informed, was so pushed with business that the exhibit had to be neglected.

The Ashton Valve Company, Boston, is exhibiting its various steam fittings which it manufactures. The quality of its goods is well known and its exhibit is a source of considerable interest.

Mr. C. B. Kennedy, secretary and treasurer of the Western Telephone Construction Company, of Chicago, was a visitor at the Exposition last week and expressed himself much pleased with his trip East.

The Ideal Electric Corporation, New York, exhibits a line of La Roche alternators, which have been some years on the market and have been very favorably received. This exhibit attracts much attention.

The New York Electrical Company, New York, shows a fine line of medical batteries of various types. The company issues also a little folder descriptive of its goods, which appears at first sight to be an X-ray treatise, as it is so indited on the cover, but on looking closer the reader is undeceived by the little sentence, "This is not," set in the finest kind of type.

The Phœnix Iron Works Company, manufacturers of engines and boilers, Meadville, Pa., is showing a very handsome 125-hp Dick & Church tandem-compound engine, direct-connected to an 80-kw Walker generator. The special catalogue descriptive of the various types of engines and boilers manufactured by this company is in great demand. Mr. C. A. White, the New York representive of the company, is in charge of the exhibit.

The New York Leather Belting Company, New York, has gone to great expense in decorating its booth, the decorations being entirely of leather. Round leather belting forms the rails which are hooked on by belt hooks. The walls and pillars are of leather, with round leather belting trimmings. In the booth are exhibited samples of the belts, and the whole structure is beautiful and appropriate, as it is significant of the interests it shelters.

The Ferracute Machine Company, Bridgeton, N. J., is exhibiting a press specially designed for enlarging armature discs. The press is shown directly connected to a motor. The company also has on exhibition a nice line of cutting presses and punching presses. Its catalogue describes over 300 different designs of presses for all kinds of work. Mr. Fred F. Smith, secretary, and Mr. W. S. Mitchell are kept busy giving information regarding the Ferracute apparatus.

Mr. Horace See, manufacturer of the Russell-See electric indicator, New York, shows a burglar alarm and indicator system working on a 110-volt circuit; also a steamship electric indicator, which gives notice of a burned-out lamp, and directly cuts in another one. A large picture of the tug boat *El Toro*, in which this system is installed, decorates the wall. A special series-bell working on a 110-volt circuit is also shown. Mr. David Killoch is in charge of the exhibit.

Mr. Henry R. Worthington, New York, exhibits a complete unit of his steam generators. The grate and fire box is lighted by incandescent lamps, so that by opening the door the inside of the boiler can be inspected. This boiler is so arranged that it can be fired either from the side or the end. It is of the water-tube type, all the tubes being straight, and its advantages are fully described by efficient assistants who are always present. This forms a part of the New York Safety Steam Power Company's exhibit.

The Peck Electrical Company, New York, exhibits a full line of carbons of the American Carbon Company, of which it is the agent. The exhibit includes battery carbons, high-tension carbons, brushes, and the like. An important portion of the exhibit is a full line of Thomas H. Brady & Co.'s goods, consisting of mast-arms, sleet-proof pulleys, arc cut-outs and similar standard contrivances. The Helios arc lamp, for which this company is the agent, lights the exhibit and makes the booth brilliant and attractive.

The Tucker Electrical Construction Company, New York, has devoted its booth to the exhibit of telephones of the desk and wall types. Types for every conceivable purpose are exhibited. A number of telephones are installed in booths about the hall and connected with the Tucker booth, so that they may be actually tested by those who care to take the trouble. James R. Stern and W. A. Moore are in the booth and receive visitors, and also talk to any one who may care to call them up from a distant station about the hall.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Newark, N. J., has a full line of its well-known instruments of various styles, as will be seen from the accompanying illustration. The engraving also shows the tasty arrangement of the exhibit. Some really interesting instruments are dis-

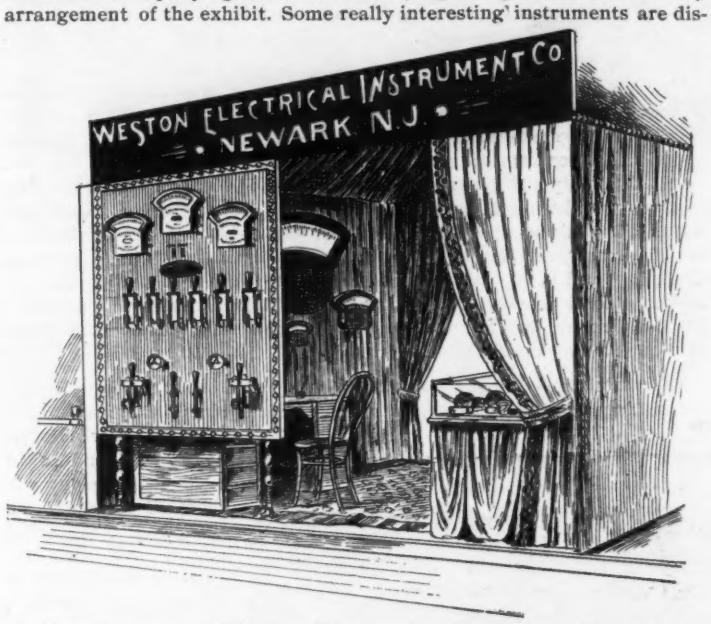


EXHIBIT OF THE WESTON ELECTRICAL INSTRUMENT COMPANY.

played, one of them being an ammeter of 80,000 amperes capacity—the largest instrument of this class ever made. The instruments shown are rendered very attractive by artistic combination with the decorations and drapery.

THE GOULD'S MANUFACTURING COMPANY, manufacturers of electric pumps, Seneca Falls, N. Y., represented by Hamilton Garnsey, exhibits a line of these well-known pumps. The special features of the exhibit are the triplex electrical pumps for house service; a pump driven by a motor pumping into a tank and controlled by an automatic switch, sizes from 1¼ by 2 to 5 by 8. A miniature plant is in actual operation. The walls are decorated with photographs illustrating the special pumps furnished for water-works and also for mill and other service.

THE TELLMIC COMPANY exhibits sections of its fire-brick clay conduits for electric wires which are made in every conceivable shape and size at the company's factory at Cartaret, N. J. Mr. W. H. Falconer represents the company.

MR. J. A. RUSSELL, who has charge of the exhibit of the Western Telephone Construction Company, Chicago, is one of the most popular telephone men at the Exposition. He is meeting many old friends and making many new ones.

MR. ROBERT A. KEASBEY, New York, has an interesting exhibit of his

EXHIBIT OF ROBERT A. KEASBEY.

well-known magnesia sectional covering for steam boilers and pipes. Sections of various diameters are arranged in piles, and a small boiler affords an example of the method of application of the magnesia covering to steam generators. An illustration of the exhibit is given herewith.

THE MICA INSULATOR COMPANY'S exhibit is tastefully draped, and on the tables there is a profusion of micanite specialties. Two large, five-foot moulded micanite rings are among the most conspicuous articles exhibited. Samples of micanite rings, segments and other parts in an almost endless variety of shapes are seen, and a large armature with micanite insulation

EXHIBIT OF THE MICA INSULATOR COMPANY.

is a prominent object at the right of the illustration. As an electrical insulating substance micanite has a well-grounded reputation.

THE CROUSE-TREMAINE CARBON COMPANY, Fostoria, O., is proud of its exhibit. The decorations are tasteful, and there is an air of good cheer about the booth. The counters on all three sides are strewn with cored and solid carbons of all sizes, and motor and dynamo brushes and carbon pencils are utilized wherever fancy and good taste suggested in the decoration of the booth. The company is intensely patriotic as may be inferred from the plentiful use of American flags, in addition to the

EXHIBIT OF THE CROUSE-TREMAINE CARBON COMPANY.

device shown at the front of the booth, of which the effigy of a "bird of freedom" forms the most important feature.

MR. F. T. EGGERS, managing director of The Electrical Company, of 122 Charing Cross Road, London, the English branch of the Allgemeine Electricitats-Gesellschaft, of Berlin, Germany, is in the United States

for a brief visit, and has been a frequent visitor to the Electrical Exposition. Mr. Eggers is anxious to secure the exclusive right to manufacture in England and Germany important electrical specialties. A good alternating-current motor is one of the things he wants. Mr. Eggers may be addressed until May 26, at the Savoy Hotel, New York, or care Mr. C. E. Chapin, 132 Liberty Street, New York.

The Williamsport Wooden Pipe Company, Williamsport, Pa., shows lengths of wooden piping treated with creosote and also wood casings for steam pipes. The company uses its process for preparing mast-arms and cross-ties, of which it exhibits samples.

Mr. C. D. Fitch, of the Elizabeth Telephone Company, Elizabeth, N. J., was a visitor at the Exposition last week, shaking hands with his old friends. Mr. Fitch claims to have built the first long-distance telephone line in this country.

J. C. Vetter & Co., New York, exhibit a line of goods which are adapted to use lighting currents for electro-therapeutic purposes. They have gone very carefully into the subject and the apparatus they exhibit is of the most refined type and is all that any surgeon could desire. Apparatus for administering shocks either direct or alternating, cauterizing apparatus, bone drillers and appliances are shown at work either with commercial lighting currents or battery currents without the least danger to the patient. The safety appliances to prevent possible accident are ingenious and interesting. Messrs. R. Wappler and Alexander Vetter are always busy in explaining their goods.

John A. Roebling's Sons' Company's booth is one of the most attractive at the Exposition. Samples of all kinds of wire and cables made by the company are shown, but the chief attraction is not the samples but the cosy and attractive appearance of the stand. The company's representatives accord each caller a hearty welcome and make him feel quite at home when in their booth. Bi-metallic wire interests are also represented in this booth, samples of which are shown.

Exhibit of John A. Roebling's Sons' Company.

The Stirling Company, Chicago, Ill., exhibits one of its large boilers in section, showing the arrangement of the tubes, baffle plates, steam and mud drums and fire fronts. It is both an expensive and attractive exhibit.

The New York Carbon Works, New York, is presenting interested callers with a little souvenir in the shape of a miniature Leclanche battery carbon.

The Electric Storage Battery Company's exhibit was added to on Saturday evening by the installation of apparatus showing the formation of storage battery plates by the Planté process. In a glass jar filled with electrolyte, two lead plates were immersed, the terminals being connected to a battery of chloride accumulators. Through a large magnifying glass placed in front of the jar the action of the current on the lead was plainly discernible. It proved an interesting feature to the crowd which watched it during the evening. On Saturday evening chloride accumulators furnished the current to operate the telegraph instruments that started the messages around the world, and also for firing the guns that announced the departure and arrival of messages.

Messrs. Fayerweather & Ladew, manufacturers of the Hoyt belt, New York, are showing a nice line of dynamo belts for heavy duty. A feature of the exhibit is a belt 147 feet long, 60 inches wide, two ply; another 108 feet long, 44 inches wide, three ply; and still another 96 feet long, 48 inches wide, two ply. They also have a nice line of twist and solid belts for electric fans, lathes, etc.; one of the souvenirs which this firm is giving out is Cox's belting computer, designed to give the width of single and double leather belting to transmit any required horse-power at any given speed, and *vice versa*. They are also giving away a handsome leather memorandum book, containing a price list of their goods. The exhibit is in charge of Mr. Frank Little, who never gets tired of entertaining visitors.

Mr. Marcus Nathan, superintendent of the New York Industrial Building, is entitled to much credit and praise for his work in connection with the great task of getting the Electrical Exposition in running order. This enterprise was an extraordinary undertaking, but Mr. Nathan's ability and experience in his line enabled him to meet the difficult work in the most satisfactory manner. Among others connected with the exposition who are entitled to commendation for their efforts to realize success, are Messrs. H. J. Smith, the president of the Exposition Company; and B. E. Greene, press agent. Mr. Smith showed great tact and conscientious effort in assisting the exhibitors in every way possible, and Mr. Greene, with his wide newspaper experience, handled the press service in a very creditable manner.

Early Books.—One of the most interesting exhibits at the exposition—interesting particularly to those who are studiously inclined, is that loaned by Mr. Park Benjamin. It consists of his well-known collection of books on electricity, beginning from the earliest times. The collection is arranged in groups, group A relating to ancient knowledge of the magnet and amber. The earliest book of this group is an English translation (early edition) the original of which was written by Theophrastus, between B. C. 273 and B. C. 287, and entitled "The History of Stones." The group is intended to show ancient knowledge concerning the attractive powers of the amber and the lodestone. The entire collection is arranged in 12 groups, each group representing an epoch in electrical progress, the final one bringing the subject up to the time of Sir Isaac Newton. Several autograph letters from Benjamin Franklin, Sir Anthony Carlisle, Sir Humphrey Davy, Robert Fulton and James Watt are also shown.

The Gamewell Fire Alarm Company's systems of police and fire alarms are the subjects of a most extensive exhibit near the southwest corner of the main hall, and the manufacturers have gone to no little expense in order to effectively display their goods. They exhibit a central station police outfit complete and all of the accessories which are commonly installed at the sub-stations. Galvanometer relays, time stamp clocks and controlling switches are not spared to make the system complete. A tower striker in connection with the various fire boxes is shown. An indicator and alarm combined, arranged for police stations, car barns or engine rooms is also shown in operation. This instrument indicates the station from which an alarm comes and records it upon a set of annunciator drops under the control of a lever at the side. Their police box is an ingenious device which will meet almost any contingency that may arise. By means of it an officer may signal to the station for a fast or slow wagon, or telephone to the station if necessary. A box is provided for use with a citizen's key, which does not open the box, but merely sends the alarm. The officer's key can send the alarm through the hole provided for the citizen's key, but the latter key is locked in when the alarm is sent, while the officer can remove his key at pleasure. The object of this is apparent. Messrs. A. L. Tinker and Charles Marden explain the system, which will be interesting to any one whether he be an electrician, policeman or ordinary citizen.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Concentric Coil Dynamos. BERTHIER. *L'Eclairage Elec.*, April 25.—The beginning of a mathematical article giving the theory of such machines.

Dynamos. BOISTEL. *L'Eclairage Elec.*, April 25.—An illustrated description of a number of prominent English alternating and continuous current machines, including the Ferranti, Mordey, Kingdon, Parker and Clark.

LIGHTS AND LIGHTING.

The Effect of Wave-Form on the Alternating-Current Arc. FRITH. London journals, May 1; a brief abstract of a Physical Society paper.—He found that the arc has the power of modifying the wave form of the circuit; thus when the open-circuit curve was decidedly peaked it was found that when it was passed through an arc lamp it was changed to a flat-topped form; the candle-power of the arc is greater for a flat-topped curve than for one that is peaked; by alternating the resistance in series with the arc it is possible to alter the character of the curve, and as this resistance increases the arc affects the wave-form less and less; when a resistance is not used in series with the arc, the wave-form is not forced on the arc, and the differences between the efficiencies obtained for the alternating-arc in the laboratory and that claimed in practice may then be accounted for. In the discussion Mr. Blakesley stated that it seemed that the more nearly the alternating-current resembles a direct-current the greater is the efficiency of the arc. Prof. S. P. Thompson said that the dynamo which had been used contained large quantities of the iron in the armature and this had a large self-induction, and he suggested that it might have been the self-induction which would tend to keep the current constant, that the arc was able to alter the wave-curve; he asks whether if the arc was connected to the mains coming from a number of machines in parallel, it would still be able to affect the wave form. Mr. Carter asked whether the effect had been tried of replacing the arc by an equivalent resistance. In reply the author said that the effect of the self-induction of the machines was shown in the curves; that current curves had not been taken with the arc straight on the machines; when special machines are used for arcs only, the latter would alter the character of the wave-form, but if the arc is replaced by a resistance the wave-form remains the same. The paper is discussed editorially in the Lond. *Elec.*, May 1, in which reference is made to Roessler and Wedding's paper read some time ago, in which they found that the highest luminous efficiency was reached with a flat-topped wave, while the lowest was obtained with a peaky wave, from which the conclusion is that the best type of alternator for arcs would be one giving a flat-topped curve; it would now appear that when used only for arcs it does not matter what the wave-form of an alternator is, but all alternators would for such purposes appear to have equal efficiencies as regards wave-form; there still is, however, a considerable element of uncertainty as to the general applicability of Frith's deductions; should it turn out that both iron-cored and non-iron-cored alternators are appreciably affected by the arcs, one may expect that some modifications of arc-lighting practice will result; since arcs running from transformers would be unable to alter the wave to their best advantage, while others running on a separate machine would; preference for the latter practice would be strengthened, all the more so since the flat-topped wave is the very worst with which to feed transformers.

The Alternating-Current Arc. GEORGES; Lond. *Elec. Rev.*, May 1; an abstract of some length, with the illustrations of the article noticed in the *Digest*, Sept. 28; see also Nov. 16.

Public Lighting by Arc Lamps. BLONDEL. Lond. *Elec.*, May 1; a continuation of his serial (see *Digest*, last week.)—He discusses the experimental comparison between different types of globes from the point of view of the utilization of the light; many series of measurements were made and a number of them are here discussed; they were made first without the globes and then with them; measurements were made with the naked arc and with ground glass, opaline, opal and holophane globes; the clearest globes gave the best distribution, but the holophane globe has a form of curve which is new and more advantageous than the others, the maximum being at 65° from the vertical instead of 45°; its only fault is that it allows too much light to be sent upward. He calculated the luminous flux and the illumination curves, diagrams of which are given, first for the normal plane, then for the vertical and finally for the horizontal plane, which three give all the elements necessary for determining the lighting; from this it appears that at short distances all the globes give rise to too much horizontal illumination, as all above 10 lux may be considered useless; from a distance equal to the height, the illumination decreases very unequally for the various globes and in this respect the holophane globe shows a marked superiority, which increases with the distance; this has been confirmed by the experimental trials of the Edison Company in Paris; a very marked increase in the illumination in favor of the holophane globes is shown by comparing two neighboring arcs, the difference amounting to as much as 60 per cent.; in another comparison the minimum illumination was raised from 0.5 to 1.25 lux, and the mean illumination from 2.35 to 5.36 lux. He thinks it would be easy with such globes to obtain a curve more nearly approaching uniformity, but he thinks the time has not yet come for uniform illumination to be realized, as we must wait until there is a sufficient luminous flux to give a mean of 8 or 10 lux before attempting it. There are two principal objections to holophane globes—the price is higher than that of opaline globes, and the globe is divided into two parts; the first is only serious at first sight, for if the annual saving of 1 or 2 amperes, which may be effected, is taken into account, it will show an economy of more than 10 per cent. in the energy, the cost of which is the greatest item; in Paris, for instance, the economy was 80 francs in the first year, which would more than cover the cost of many globes.

Exhausting Incandescent Lamps. Zeit. f. Beleucht., April 30.—A short article describing a process used by Roeder in Germany, in which a chemical process is used in conjunction with the air pump; it is stated that most of the lamp factories in Germany are now using such chemical processes. In the tube attached to the lamp for exhausting it, a piece of amorphous red phosphorus is introduced, the amount of which must be found empirically for each type of lamp; while it is being exhausted with the pump, this tube is heated carefully with a Bunsen burner; when the vacuum is sufficient, the normal current is passed through the lamp and then increased gradually up to about three times the normal voltage, when a violet light will appear at the end of the filament; a few moments later a blue light will appear around the filament; the current should be reversed frequently; after having run for 10 to 20 seconds at the high voltage, the blue light will expand throughout the whole globe and at that moment the lamp must be sealed off, so as to include the phosphorus; the lamp is then run again and heated at the tube which contains the phosphorus. A reaction will suddenly take place and the blue light will disappear, a scarcely visible light brown deposit being formed on the glass, which it is said does not affect the candle-power; when a lamp exhausted in this way is tested with a Ruhmkorff coil, neither phosphorescence nor a current will be found to exist; the whole operation requires only 1.5 to two minutes with an experienced workman.

Glucinum for Leading-in Wires. Lond. *Elec. Eng.*, May 1.—In calling attention to the use of this metal (also called beryllium) for electrical work, it is stated that its coefficient of expansion is the same as that of platinum, and it could therefore be used instead of that metal in incandescent lamps; its lower melting point, however, should be considered.

Coast and Lighthouse Illumination in France. PRELLER. Lond. *Eng'ing*, May 1.—The beginning of an article with occasional reference to electric lights.

Advantages of the Electric Light. SHEPHERDSON. *Improvement Bulletin*, April 17; a reprint of a short paper recently read before the Institute of Architects.—He makes a distinction between "illumination" and "illumination appearance," the former referring to the cases in which the lighted surfaces form the chief objects of vision, and the latter to lighthouses and display advertising in which the lights themselves should be the most conspicuous objects; the distinction between these two different kinds is not as well recognized as it ought to be. Illumination appearance is obtained by making the sources of light conspicuous; illumination, on the other hand, is found in daylight where the source of light is rarely looked at directly; for perfect illumination the source of light should be entirely outside of the range of vision; the angle of vision extends from 50 to 95 degrees to each side of the centre line of vision, as measured from the eye, and the source of light should therefore be well outside of this angle, since the eye adapts itself to the strongest light within this field; other objects cannot be seen so clearly if the source of light comes within the field of vision; failure to recognize the difference between illumination and illumination appearance often leads to serious mistakes in lighting public halls; examples of the different kinds are referred to and the advantages of electric lighting over other artificial methods are discussed.

The Middle Age of Electric Lighting. Pope. *Elec. Power*, May.—A short article containing some interesting history for a period about 10 years ago.

POWER AND HEAT.

Development of Electric Lighting Engines. Lindley. *Eng. Mag.*, May.—An abstract of a recent paper read before the Northern Society of Electrical Engineers.

TRACTION.

Disturbances in Telephone Lines Due to Electric Railroads. West. *Elek. Zeit.*, April 30.—In the *Digest* last week it was stated that a test had been made which confirmed the suggestion that the cause of disturbances might be looked for in the contact resistance at the rail; the present article describes this test. If the view is correct the noise would differ with different roadbeds; the noise was found to be much greater on lines with a hard bedding under the rails than with a cushioned foundation, such as when the rails are laid on wood; the frequency of the vibration should also be different. The test was made on a line in which three different kinds of foundation were used; it was made with a small car used as a trailer and coupled with an insulating cable: the two trucks were connected through a battery of two cells and through the primaries of three induction coils connected in parallel, the current being completed through the rails; the secondary current was passed through a telephone; three coils were used to get a lower resistance; the results showed that where the rails were laid on wood the noise in the telephone was least, while it was stronger where the stone foundation was used and strongest when the foundation was of concrete; when the speed of the car was increased the noise had the same intensity on the wooden foundation, slightly greater on the stone and much greater on the concrete; not only was the intensity greater, but the frequency of the crackling sound was decidedly greater; whether the noise increased in going around the curve could not be determined, as it was so loud that an increase could not have been noticed. The results show distinctly that the periodic changes in the resistance between the wheels and the rails depend very largely on the construction of the roadbed.

Electric Railways and Telegraphic Disturbances. Lond. *Elec.*, May 1; a translation of the editorial discussion from the German, noticed in the *Digest* last week.

Three-Phase Traction at Lugano. Elek. Zeit., April 30.—In an extract from the official report on telephony in Switzerland it is stated that this railway was constructed without approval, and that during the experimental trips so much disturbance was produced in the telephone lines that the running on the railway had to be stopped; the telephone lines in that city will have to be reconstructed completely in order to shield them from the effects of this railway. (The report was for the year 1895, and it is possible that the recently reported trials of this road were made subsequently.)

Gas-Engine Power-Plant. Lond. *Elec. Eng.*, May 1.—A brief statement to the effect that a short line in Zurich has been operated for about nine months with gas engines and producer gas, in connection with accumulators at the station; no figures are at present available to show whether there is any economy over the use of steam engines; the management considers the working and the results to be satisfactory.

Road Carriage Competition. Lond. *Elec. Rev.*, May 1.—A statement of the conditions for the coming international competition of the London *Engineer*.

Electricity and the Horseless Carriage-Problem. Baxter. *Eng. Mag.*, May.—He discusses the various sources of power, and points out the advantages of electricity. Steam has failed for a number of reasons; the maximum horizontal effort which it is capable to impart to the vehicle is limited and is not much greater than at full capacity; the attention required is such that one man cannot well look after it and operate the vehicle; if the boiler is neglected a halt is necessary; a skilled attendant is required to reduce the danger of an explosion; an engine can never be perfectly balanced, and therefore requires a strong frame; besides this there are other objections, but the first one he considers the principal one. Regarding the gas and oil engines he states that they are no better off in regard to the maximum horizontal effort, but they can be operated by one man which is their only real advantage; they cannot be started unaided and require a battery or some equivalent device to furnish the spark for the explosion; it is not apparent why the engines should be lighter than those for steam, although claims to that effect are made. The electric motor cannot be installed by any resistance within practical limits; a one hp-motor sufficient for a speed of 1000 feet per minute against a resistance of say 33 pounds, could instantly develop an effort great enough to overcome a resistance of 300 to 400 pounds if the occasion required it, as it is not likely that this would last more than a few seconds; from a mechanical standpoint, the machine is the embodiment of simplicity; it is exceedingly light, very compact, will always start and can be controlled with a greater certainty and requires little attention; the only thing that stands in the way of the complete solution of the problem is the storage battery, "but at the present time they are not so far from perfect as the great majority of electricians believe"; their greatest defeat is their inability to withstand a rapid rate of charge and discharge; if the time of the discharge could be reduced to one hour the number and weight of the cells could be reduced to one tenth of that of a battery which cannot be discharged in less than 10 hours; the average weight of the batteries now on the market is about 140 pounds per horse-power-hour with a discharge rate of 10 hours, and therefore a vehicle requiring two horse-power would have to carry 2800 pounds of batteries and would be able to run for 10 hours; if it could be discharged in two hours and weight 70 pounds per horse-power-hour, the total weight could be reduced to 280 pounds; there are no such batteries on the market at the present time, but the results are within the limits of possibility, and some of the most able workers in this field have already obtained even better results; the weight of the material which undergoes chemical change is about 11 pounds per horse-power-hour, and everything above that is the weight of cells, supports, fluid, etc.; a reduction of weight to 30 or 25 pounds is then possible, although there is not much probability of obtaining this in the near future; but the possibilities already in sight are sufficient to ensure success in this field. For propelling pleasure vehicles for taking long runs, electric wagons will be useful, but their legitimate field is as express and parcel delivery wagons, hacks, drays, etc., in which field they would be successful in the highest degree. It is claimed that the cost of operating such wagons is greater than that for either gasoline or gas, and this is true if the mere cost of the energy is considered, but if all the expenses are considered the balance is in favor of electricity; the most important advantage, however, is that it is always ready and able to cope with an emergency; a wagon weighing two tons with load would require a horizontal effort of about 60 pounds on a level, well-paved street, but occasionally an effort of several hundred pounds would be required which the electric motor would be able to meet; this cannot be said of any other.

Recording Wattmeters in Railway Practice. Haskins. *St. Ry. Jour.*, May.—A description of the Thomson recording wattmeter, which is now largely used in railway work; a portable instrument is also described in which the frame is carried on two networks of rubber cord woven into hammocks, one above and the other below the meter, thus enabling it to be used on a movable street car even over the roughest roads; the importance of the use of some such instrument is pointed out.

Conduit Road in Washington. St. Ry. Jour., May.—An illustrated description of some of the modifications adopted by this road in the extension of the 12½ miles which is being made.

Seashore Railway. St. Ry. Jour., May.—An illustrated description of the line on which the car runs through the water, described in the *Digest*, Nov. 30.

Staten Island. St. Ry. Jour., May.—An illustrated description of the Staten Island electric railway company's system.

Present and Prospective Development of Electric Tramways. Field. *Trans. Am. Soc. Mech. Eng.*, 1895.—A reprint of the complete paper which was read in December, 1894, together with a very long discussion in which several conduit systems are described and illustrated.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central-Station Statistics. Lond. *Elec. Rev.*, May 1.—A supplement in the form of a large table containing a list of the central lighting stations in the United Kingdom, with a brief descriptive paragraph after each one. The statistics are briefly discussed editorially. The past year has not been remarkable for the number of new stations, not more than 14 or 15 having been opened, which is considerably less than the year before; but it should be remembered that the most important towns are now supplied and the greater part of the progress has appeared in the extension of existing stations; in England there are 66 towns with a population of over 30,000 that have no central station, although in some of these they are in the course of construction. The advantages of municipal ownership is clearly shown by the majority of the municipal plants; most of the stations opened during the past year are owned and controlled by the municipalities; out of 13 only 3 belong to companies. There is a greater uniformity in the charges than might be expected, and in the majority of cases the Wright method of charging is in use; the safest indication of the character of a district is the income derived per lamp; the lowest revenue per 8-cp lamp is obtained by the Kelvinside Company, and was 66 cents per lamp.

Steam Turbine Installation. Lond. *Elec. Eng.*, May 1.—A description of the plant at Hotel Cecil, in which four turbo-dynamos of the Parsons type are used, each having a capacity of 75 kilowatts, with a speed of 4000 revolutions; the plant, when finished, will supply 15,000 lights; illustrations of the steam dynamo are given.

Statistics for the United States. Elec. Eng., May 13.—An editorial statement saying that at the present time there are sent in the United States 65,000,000 telegrams per year and 750,000,000 telephonic conversations; there are 2,700 central lighting stations and about 7,000 isolated plants; there are not less than 15,000,000 to 20,000,000 incandescent lamps while the number of arc lamps is about 1,000,000; the number of motors is believed to be 500,000; there are 1000 trolley roads with 12,000 miles of track and 25,000 cars; the investment in mining plants is estimated to have reached $100,000,000 and in electrical power transmission $50,000,000; the total capital represented in the various electrical industries amounts to fully $1,500,000,000; at least 2,500,000 people are directly or closely dependent on electricity for their sustenance.

Relations of the Underwriter to the Electrical Engineer. BROPHY. *Elec. Power*, May.—A short article in which he discusses the subject of rules and inspections, pointing out the importance of having the inspection conducted by men of ability and integrity; when the inspection is maintained by municipal authorities, insurance inspection should be dispensed with; he criticises unfavorably the Underwriters National Electrical Association and their rules, and thinks the time has come for electrical engineers to form the rules while the underwriters, with the aid of the honest men in the electrical business, will enforce them.

Electrical Engineering in Modern Central Stations. FERGUSON. *Bul. Univ. Wis.*, April; published also under separate cover.—A reprint of a long lecture, in which he discusses the subject of the construction and operation of central stations in general, and a description without illustrations of the Harrison Street station of the Chicago Edison Co.; in conclusion he points out the advantages of storage batteries as an adjunct to direct-current stations.

Test of Combined Electric Light and Railway Central Station. JACKSON and RICHTER. *Trans. Am. Soc. Mech. Eng.*, 1895.—A reprint of their complete paper read last June and referring to the combined station at Madison, Wis.

Storage Batteries. BLIZARD. *Elec. Power*, May.—An illustrated article in which he outlines briefly the application of batteries abroad, showing the extent to which they are used there, and gives brief references to the more important applications in this country for the past two or three years.

ELECTRO-PHYSICS AND MAGNETISM.

Diffraction of X-Rays. BUNGETZIANO. *L'Eclairage Elec.*, April 25.—A communication describing experiments which he believes show conclusively that X-rays may be made to interfere by diffraction; photographic images were made by passing the rays through the neck of a funnel in which was placed a hollow glass tube; after 25 minutes exposure the image produced consisted of a large white spot at the centre, surrounded by two circular fringes due to diffraction; the photographic records (which are not reproduced) are said editorially to have shown this result very clearly, but they did not stand reproduction; other experiments were made by using circular openings in metallic screens with which very perfect records were produced, the interference rings being shown very clearly, one peculiarity being that some of the fringes were eccentric, and it appeared as though there was a tendency to form two other luminous points to the right and left of the central point; the best interference fringe was produced around the central one; it is thought that this showed the existence of several centres of emission of the rays; another experiment made with a 2-mm hole showed the same results, the interference fringes being produced with a regularity like those formed by light. He believes that this shows clearly that X-rays, or at least some of them, possess the property of interference by diffraction; this shows that the hypothesis of molecular bombardment does not hold good, as these rays have a periodicity; it becomes possible to measure the lengths of the waves from these rings, but insufficient means prevented him from making these measurements; he calls attention to the importance of the intensity of the current, the regularity of the interruptions, the direction of the rays, the distance to the screen and to the tube, the duration of the exposure, etc., all of which factors influence the result and should be considered; it is probably due to the absence of the best conditions, that others have not been successful with these experiments. Editorially it is thought that too much reliance should not be placed on these results until they have been confirmed, as the results might also be explained by assuming them to be due to several centres of emission of the rays.

Röntgen Rays. SAHULKA. *Zeit. f. Elek.*, April 15.—A description of some experiments made some months ago; among other things he suggests that interference experiments might be made by having a cathode at each end of a tube, with corresponding anodes at the sides, and in the middle a movable fluorescent disc; by this means the wave-lengths might possibly be measured. (This, it seems, would apply to the cathode rays inside of the tube; that these are the same as the Röntgen rays outside of the tube has not yet been demonstrated; the contrary is believed to be the case.)

Röntgen Radiations.—The Lond. *Elec. Eng.*, May 1, calls attention to the fact that if Röntgen rays are made up of undulations of widely differing wave-lengths, any attempt to get interference phenomena will be difficult if not hopeless until some means are obtained for separating out monochromatic radiations.

Recent Researches on the Röntgen Rays. GUILLAUME. *La Nature*, April 25; translated in abstract with the illustrations in the Lond. *Elec. Rev.*, May 1.—He gives an account of recent work done principally by French physicists. He thinks "it will be from France this time that the general idea will start, which is to connect the new discovery to known phenomena. A number of results summarized in this paper have already been given in these columns; he describes and illustrates a method used by Batelli and Garbasso, who think they have found a kind of diffuse reflection; the present writer, however, does not think the results are absolutely convincing, as compounds of zinc are capable of giving by phosphoresence visible or invisible radiations, certain of which traverse opaque bodies; the impression on the photographic plate in these experiments may have been due to secondary rays and not to reflected rays. Perrin, by using prisms of aluminum, claims to have found an index of refraction equal to 0.9996, but it is not thought to be very reliable; it would agree with the theory that the new rays are luminous vibrations of very small wave-length. The apparatus used by Benoist and Hurmuzescu for showing the property of discharging electrical bodies is illustrated; their experiments showed that the rays are different, depending upon how the tube is excited; they do not form a homogeneous beam and are not monochromatic; they possess in different degrees the power of discharging bodies; after passing through a sheet of aluminum 0.1 mm in thickness to intensity is reduced to 0.8 or 0.9 parts of the original; data regarding the transparency of bodies should refer to a well-defined quality of the rays as they are otherwise of little value, and it is thought to be due to this that such divergent results have been obtained. The variations of the conductivity of the metalloids under the action of the X-rays present a striking analogy with the phenomenon which takes place in fused selenium. A careful examination of the properties of the rays shows that they are those of a certain kind of light with a somewhat greater intensity; oscillations of very short wave-lengths could traverse all bodies; when the length approaches the size of the molecule "matter appears for the movement of the ether with a certain discontinuity, and the wave traverses it without much difficulty"; at the same time absorption, reflection and refraction ought to disappear.

Theory of X-Rays. GOLDHAMMER. Lond. *Elec.*, May 1; abstracted briefly from the *Wied. Ann.*—In a short paper he argues that the properties of these rays are consistent with the assumption that they are very short ultra-violet waves; such waves would be too small to be reflected by ordinary surfaces, and for the same reason they could not be polarized; it appears, however, that these could be tested by trying reflections from liquid surfaces which would need no polishing; he gives no reasons against the assumption of longitudinal waves, but simply points out "that in several theories of distribution there is no deviation of infinitely small waves—which would account for the absence of refraction."

Small Röntgen-Ray Tube. COLARDEAU. *L'Eclairage Elec.*, April 25; a brief abstract of a Physical Society paper.—He made a very small cylindrical Crookes tube, having a cathode disc, whose diameter was equal to that of the tube and placed at a very small distance from the anticathodic disc; the size of the tube was about equal to that of an ordinary cigarette; as its small capacity causes the vacuum to change rapidly, it is best in practice to connect it laterally with a sufficiently large bulb; a number of photographs were exhibited which left no doubt that the sharpness of the image was increased by the use of these small tubes.

Röntgen Rays. BARR. Lond. *Elec.*, May 1; a brief communication.—He states that experiment has shown that reversing the current in a focusing tube improves it after fatiguing has set in; the revival due to the reversed current it seems is caused by the generation of heat in some particular spot; he therefore intends to try the effects of a flow of current in the platinum disc during the action of the tube; an illustration is given showing how he intends to carry it out.

Crookes Tube Phenomenon and a Method of Preparing Tubes. SESTINI. Lond. *Elec Rev.*, May 1; translation from *Nuovo Cimento*, February.—He refers to the variations in the intensities of the Röntgen rays and the differences in the times of exposure; in an experiment of Crookes the platinum electrodes were caused to absorb the last traces of nitrogen contained in the argon confined in the tube; it is therefore natural that a tube subjected to discharges should undergo gradual variations, and he thinks the variations of the Röntgen rays may be ascribed to this fact; he made a number of experiments, among others some spectroscopic researches; he thinks that Röntgen rays are formed only when the greater part of the gases remaining in the tubes have been absorbed, and he does not think the disaggregation of the glass can be regarded as the sole cause of the phenomenon; he sums up the results of his experiments by saying that the variations of the Röntgen light are intimately connected with the quantity of gas absorbed by the electrodes; also that the variation does no occur in tubes pushed to the final rarefaction, then refilled with a gas such as watery vapor which may be easily absorbed by the metallic electrode, and the final rarefaction then pushed to a few millimetres.

Electro-Chemical Action of the Röntgen Rays on Silver Bromide. STREINITZ. *Phil. Mag.*, May; translated from the *Wiener Berichte*, Feb. 6.—He thought it likely that electro-chemical changes will be produced by Röntgen rays and describes some experiments; a piece of platinum foil coated with silver bromide when "combined in dilute potassium bromide solutions with a standard electrode" showed sensitiveness to light; when a Röntgen ray tube was substituted for the light a diminution in the E. M. F. could also be observed.

Contact Electricity. CHRISTIANSEN. Lond. *Elec.*, May 1; a mention of a paper in the *Wied. Ann.*—Among gases he found oxygen and hydrochloric acid to be the only ones capable of producing a difference of potential between mercury amalgams; but in any case some gas is necessary.

Steel for Dynamos. Elek. Zeit., April 30.—A reprint of a report made by Prof. Ewing of a cast steel for dynamos, made by the Krupp Company; the results agreed with those made by the Reichanstalt, and are given in the form of tables and curves which show that this material in

general is somewhat better than the average of those made in England. The report concludes with the statement that the results show this to be a very good material for the magnets of the dynamo; that it differs but little in its magnetic qualities from the best wrought iron; its permeability at low magnetization is unusually high and in this it exceeds not only all cast steel but all wrought metal for dynamos, which has come to his notice; the coercive force is specially low and it therefore has an exceptionally low hysteresis loss.

Ellipsoids. Grotrian. Lond. *Elec.*, May 1; a brief mention of a paper in the *Wied. Ann.*—He gives an experimental proof of the truth of the theorem that an ellipsoid will be uniformly magnetized throughout in a uniform field; owing to the difficulty of winding coils around the ellipsoids, he used an iron sphere, with which he found that the theoretical conclusions were very closely verified.

Effects of Magnetic Stress on Magnetostriction. Nagaoka and Jones. *Phil. Mag.*, May.—A short paper discussing the literature on the subject.

Velocity of Electricity. Le Clear. *Pop. Sc. Mo.*, March.—Owing to the popular use of the words "current of electricity," it is generally thought that electricity flows from a certain velocity, but as we do not know that there is any such fluid it can hardly be said that it has a velocity; he refers to a test made some years ago to find the time it takes a signal to be sent over a long telegraph wire, and then shows why the velocity found is not really the velocity of the electricity; he explains in simple terms how a magnetic field is generated around a wire conveying a current and shows that it is the generation of this field that should be considered; Hertz has shown that this field starts first near the wire and is propagated out from it with a perfectly definite rate which is equal to the velocity of light; he shows that in the experiment above referred to the result is not the time it takes the electricity to pass over the wire, but it is the time it takes the current to grow to its full strength; with different coils in the instruments used, it will take different times to send the signals; it is space around a wire carrying a current that should be investigated rather than the question of what takes place in the wire.

Röntgen Rays. The *Elec. Eng.*, May 13.—A statement that Mr. Falk, the author of the article abstracted in the *Digest*, May 9, is an imposter and that his statements are not true.

Commutator for Storage Batteries. Stine. *El'ty*, May 13.—An illustrated description of a simple form of mercury commutator for a battery of 60 cells, enabling them to be coupled in any desired way; it is the one used at the Armour Institute. It is made of a thick board with mercury cups and troughs; the two terminals are represented by two troughs while the poles of the batteries are represented by mercury cups which can be variously connected with each other and with the troughs; one of the chief features of the design is to prevent the possibility of short-circuiting a cell, which is accomplished by staggering the rows of cups and spacing them so that the connections cannot be misplaced.

Carbon Consuming Batteries. Elec. Eng., May 13.—An illustration of the Jacques primary battery described in the *Digest*, March 28, and including one of a battery of 100 cells each 12 inches deep and 1.5 inches in diameter; a recent test made by Stone and Webster show that this maintained 30 lamps of 16-candle-power at full brilliancy for 18.75 hours, "requiring the consumption in the pots, by oxidation, of about eight pounds of carbon" (the amount used in the furnace is not given); the average voltage of the battery was 90 and the current 16 amperes; they report that the electrical energy actually obtained from "the carbon consumed in the pots" was 82 per cent. of the theoretical.

Electrometallurgy of Aluminum. Richards. *Jour. Frank. Inst.*, May —A reprint of a long lecture discussing the subject in general, the aluminum ores and the electric processes, illustrated descriptions of the various plants in operation being given, including that at the Rhine falls.

ELECTRO-CHEMISTRY AND BATTERIES.

Caustic Soda and Bleach. Holland and Richardson process. Lond. *Eng'ing*, April 24.—A brief description of the works at which this process is being used. In the usual process of the manufacture of caustic soda and bleach there is a loss of about five-sixths of the chlorine in the salt, which makes the process expensive, and it is objectionable owing to the poisonous gases evolved. It is claimed that all electrolytic processes have resulted in failure with the exception of the present; this has been worked continuously for two years and has now been developed into a practical commercial system. In the process caustic soda and bleaching powder are produced without any loss of chlorine or waste of labor; the rock salt is dissolved in water and is electrolyzed in 200 tanks "of a special patented design" not described; the anodes consist of small blocks of ordinary gas retort carbon set in lead, and the cathodes are cast iron grids; the anodes last about eight months with continuous work; during the decomposition the strength of the solution is maintained by the addition of salt; the soda solution is drawn off when it contains about 12 per cent. of the alkaline; the chlorine is gathered as gas and is passed through lime for four or five days during which time the lime has absorbed the requisite quantity of gas to form chloride of lime containing 36 per cent. of chlorine; the product of one charge is 20 to 25 tons of bleach; the soda is concentrated in furnaces and is filled into drums while hot, where it soon sets. The current is produced by two Parsons turbo-dynamos, one of 1100 horse-power combined, which work at 120 volts and 3750 amperes; the output of the present works is 160 tons of bleach and caustic soda per week; the plant is being doubled and is to be quadrupled during the present year; the products command a ready sale owing to their purity and high quality; the plant is by no means costly; it is thought that there will be a considerable reduction in the price of caustic soda, bleach, chlorate of potash, chloroform and other chlorine products.

Coloring Matters Produced by Electrolysis. Lond. *Elec. Rev.*, May 1.—It was discovered last year that certain orange coloring matters could be obtained by electrolysis, by a process which is now being used in Switzerland on a commercial scale; when the yellow alkaline condensation products of p-nitrotoluene sulphonic acid is reduced in an alkaline solution by electrolysis, the coloring matter is converted into orange dyestuffs; a mercury cathode is preferable; the best current strength is 5 to 15 amperes per square decimetre of cathode.

Electric Tanning. Montpellier. *L'Elec.*, May 2.—A brief description of the Worms & Bale, the Groth and the new Groth systems, with special reference to the latter.

Plating Aluminum. Rev. Gen. des Sc., No. 4.—The object is first cleaned with a hot solution of soda or potash, which will make the surface porous; it is then cleaned and carefully washed in flowing water and then immersed for a moment in hot hydrochloric acid, which covers it with a layer of chloride of aluminum, and this prevents it from being oxidized; it is then washed in water and immersed in concentrated and slightly acidulated copper solution in which an adherent deposit of copper will be formed on it.

Polarization. Streinitz. Lond. *Elec.*, May 1; a brief notice of a paper in the *Wied. Ann.*—He shows that the resistance of a cell is an indefinite function of the current intensity, and that polarization, even if it could be determined, would be incapable of being logically defined on the basis of present conceptions; the only solution is to abandon the idea of ohmic resistance as applied to a cell capable of polarization.

A Cell of High E. M. F. Lond. *Elec. Rev.*, May 1; abstracted from *Comptes Rendus*, 121, page 251.—The positive pole is a plate of retort carbon and the negative is amalgamated zinc; the former is placed in a solution, 3 to 1 by volume, of potassium, bichromate and sulphuric acid with a few crystals of the former; this contains a porous cup in which is placed caustic soda 1.05 sp. gr., and in this is placed a second one filled with caustic soda of 1.25 sp. gr., which latter contains the zinc pole; the voltage is 2.5, and is said to remain above 2.4 for 10 hours; the internal resistance (the size of the cell is not given) is 0.8; a coating is formed on the zinc, which may be removed every 10 hours by dipping in dilute acid.

Rustless Coatings for Iron and Steel. Wood. *Trans. Am. Soc. Mech. Eng.*, 1895.—A very long paper, forming the second of a series of three, in which there are some references to galvanizing and the electrochemical treatment. He compares the dry (the ordinary) method with the wet or electrolytic method, and claims that fallacies have existed for a long time as to their relative merits; the wet methods are discussed at some length, and the Copper-Coles process, in which the difficulties formerly encountered are claimed to have been overcome, is described. The industrial importance of the successful application of the wet process, he states, can hardly be overestimated, even if applied only to marine constructions; the permanency, continuity, strength and density of the coating was found in all respects to be equal to that in the hot process, and the thickness may be made greater. The internal electrochemical process of protection does not appear as chimerical as one might at first suppose; Wurtz proposed the protection of mining plants, subjected to corrosive action due to the ores, by connecting all the metal portions of the mine to the negative pole of a dynamo of sufficient strength to counteract the action of the ores, the positive pole being connected to a mass of coke in the mine sump.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Potentiometer. Fisher. Lond. *Elec.*, May 1; a continuation of his serial (see *Digest*, April 4.) The present portion is devoted to resistance standards, the importance of which in such measurements is evident; a number of hints regarding the way in which they should and should not be made are given, and the final forms adopted are illustrated. No good results were obtained until the points for attaching the potential wires were placed well within the area of the alloy itself, and not of the copper terminals; the equapotential lines on a sheet of alloy were measured when the current was let in and out at different points, the results being shown by illustrations; these lines become straight and parallel with each other when the current is let in and out by means of thin copper connections extending the whole width of the sheet; the method of making the connections for the potential wires is shown, but is not very clearly described; it was found best to adopt considerably thicker sheets of the resistance strips than were formerly used, as this gives them a much longer life and makes them much more reliable; one method of adjusting standard coils was to use a fine wire shunt, but this has now been abandoned as it was found preferable to wind the coils with bare wire slightly below the desired value and then remove the metal by scraping. Various types of standard resistance used, are shown; for 150 to 300 amperes a sheet is used having alternate saw cuts from the two ends; for 1500

amperes a single test is used. Regarding materials he states that German silver and platinoid are unsuitable, the former on account of its short life, and the latter because it varies in course of time, especially if it has become heated; constantan is better; Krupp metal has the fault of oxidizing if subjected to atmospheric influences; after trying all known alloys, manganin was found to be undoubtedly the best and most reliable and it is now possible to obtain the metal with a guaranteed specific resistance; some annealing and ageing curves are shown, and it is thought possible that by the combination of two different alloys, one having a negative and the other a positive temperature error, one might produce a resistance in which it may be made negligible between zero and 100° C. In the description of the low resistance as constructed streams of water are used to keep the resistance cold: an experiment to see whether such apparatus could be connected with earthed systems showed that no danger need be anticipated from leakage provided an india-rubber hose at least 30 inches long is used.

New Method of Drawing Alternating-Current Curves. DREXLER. *Zeit. f. Elek.*, April 15.—He describes a method in which the curves are drawn automatically like an indicator diagram, requiring only a few seconds. A small bipolar non-synchronous motor is connected in the circuit, the speed of which is very slightly below that corresponding to synchronism; this carries an insulated disc with only one contact; the fact that its speed is slightly below that of synchronism makes it possible to use a fixed brush instead of one revolving around an axis; the time between successive contacts made by the brush will be slightly less than one period and the contacts will therefore correspond with successive points on the curve; the current flowing through this contact is passed through a galvanometer without iron and with as little self-induction as possible; the field of this galvanometer is very strong and is generated by one or two coils between which revolves the movable coil having but few windings and suspended by two torsion wires like in the d'Arsonval instrument; the pointer is connected with the secondary of an induction coil, producing sparks between it and a plate beneath it, which sparks pass through photographic paper, thereby registering the deflection; the paper is carried on a drum revolving by clockwork with a constant speed; it is best to connect the drum with the positive pole and the pointer with a negative, as the image produced is then sharper (several of these curves are shown, consisting of a rather thick blended white line on a black background); in place of the non-synchronous motor a continuous-current motor might be used if its speed can be carefully adjusted so as to be slightly less than that of synchronism; if this speed is too high two diametrically opposite contacts may by used and the speed reduced to one half; instead of photographic paper, which requires the apparatus to be used in a dark room, chemical paper, such as that prepared with potassium iodide, could be used.

Localization of Faults in Electric Light Mains. RAPHAEL. Lond. *Elec.*, May 1; beginning of a series of articles taken from a forthcoming work to be published.—The present portion deals with insulation testing of low-pressure networks during working. When one main is permanently earthed throughout its length it is impossible to test the fault resistance of the others while working; such networks should be provided with fault signaling apparatus, which he intends to describe later. At some central stations one of the mains is permanently earthed at the station through an ammeter, but is insulated at every other point; except in the case of a suddenly appearing fault, the reading of this ammeter is not a sufficient indication of the state of the insulation of the network, even though it is usually considered so; a fault in the middle wire must be very bad to show an appreciable deflection; if the fault resistance of the positive and negative were equal, in a three-wire network, no current would pass through the ammeter. He discusses the subject analytically, showing that this ammeter can be depended upon only partially, but it is better than nothing at all; the equations connecting the current through the instrument with the fault resistance are given. He then discusses networks which are not permanently earthed; these should be tested frequently by one of four different methods; the first of these is the use of an ammeter or voltmeter which reads to both sides of the zero, and has one terminal connected to earth and the other in turn to each main; the conditions are discussed mathematically; a method frequently used is to connect the voltmeter between each of the two outer mains and the earth, and if the readings are not alike there is supposed to be a fault on one of the outer mains, while if they are equal the middle main is thought to be faulty; he shows the error and insufficiency of this method, giving a number of numerical examples, including the readings taken under those conditions, to show how unsuitable a voltmeter is for the test when the insulation resistance of the network is low.

Adjustment of the Kelvin Bridge. APPLEYARD. London journals, May 1; a brief abstract of a Physical Society paper.—He refers to a recent paper by Reeves (*Digest*, April 11) describing a modified form of Kelvin bridge in which a double adjustment is necessary; the present author proposes to use two wires, stretched side by side, with a sliding contact in connection with the galvanometer on each; these contacts are rigidly connected together so that the segments into which one wire is divided necessarily bear to one another the same ratio as do the segments of the other wire; hence a single adjustment is sufficient to give balance. In the discussion Mr. Reeves stated that the object of his arrangement was to use such resistance coils as are always to be found in the laboratory. Prof. Ayrton stated that the method was ingenious but did not obviate the necessity for many of Mr. Reeves' additions. Mr. Appleyard in reply stated that his instrument was designed for use in a factory where the time saved in making the tests was of more importance than the cost of the instrument.

Wheatstone Bridge for Low Resistances. REEVES. *Phil. Mag.*, May.—A reprint of the complete paper abstracted in the *Digest*, April 11.

Measuring Volts and Amperes in Electrolytic Work. PAULI. *Electrochem. Zeit.*, April.—He points out the importance of very accurate measurement of the voltage in electrolytic work, and describes an apparatus devised by him for its accurate measurement, in which the ordinary torsion galvanometer constitutes the measuring instrument; the description is not very clear.

Ampere and Voltmeters. RAPS. *Elek. Zeit.*, April 30.—An illustrated description of the commercial instruments made by Siemens & Halske; the principle of which is like that of the Weston instruments, which they also resemble in their construction.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Grounds on Alternating-Current Circuits. HEINRICH. *El'ty*, May 6.—An article describing several methods and giving the necessary formulas for making these measurements. The measurements must be made on the high-tension primary circuit and the instrument must be capable of withstanding the maximum voltage; an electrostatic instrument therefore suggests itself; the voltmeter may be placed successively between each main and the ground; this must be followed by another pair of measurements in which the instrument is shunted with a known resistance; the formulas to be used are given and are independent of the voltage between the mains; if the latter is constant, three measurements will suffice; he shows how calculations may be simplified by choosing certain convenient relations. The same method may be used with an instrument of the electro-dynamometer type, such as the Weston alternating-current instrument, which has advantages over the electrostatic voltmeter for measurements of this kind, one of which is that its range may be changed by altering the resistance, a fact which may be important in obtaining convenient deflections. He also describes a convenient graphical method by means of which the calculations are reduced to a reading on the diagram.

Elimination of Surface Leakage. MONELL. *Elec. Power*, April.—An illustrated description of a method for avoiding surface leakage when testing the insulating qualities of oiled and silk paper, etc., the essential principle of which is that the leakage around the edges is taken up by a wire placed around them and connected with the same pole of the source to which the galvanometer is connected, thus acting as a shunt around the galvanometer; the leakage therefore does not pass through the instrument. It is precisely the same method as was described and illustrated in the *Digest*, Dec. 28.

How to Make and Use a Simple Spectro-Photometer. BIRCHMORE. *Prog. Age*, May 1.—A brief, illustrated description of a form of instrument consisting simply of a slot, prism, screen and two reflectors, by means of which latter the light from two sources may be passed through the same slot and prism in order to enable the two spectra to be compared with each other.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Dynamos for Telegraph Working. SLINGO and BROOKER. Lond. *Elec. Rev.*, May 1.—An article showing the advantages of storage batteries for telegraphy, and describing the way in which they are used; they also point out the advantages of using dynamos directly and describe the installation in Chicago, but they think that a much more reliable and flexible system could be obtained by means of motor generators run from lighting or power mains which are always available at a large telegraph station; it will be more efficient and much cheaper than either secondary batteries or dynamos, and they could be used in much smaller stations than those in which it would pay to install either of the others.

Telephone and Telegraph Line. Elec. Rev., May 1; the conclusion of the article noticed in the *Digest* last week.—After describing the Cailho method he suggests a problem in which eight villages are to be connected to two main offices, solutions to which are to be given.

Recent Improvements in Railway Telegraphs. LANGDON. Lond. *Elec. Eng.*, May 1; the beginning a reprint of an Institution paper.—In the present portion he discusses the subject of poles and arms.

The Telegraph Monopoly. Eng. Mag., May 2; brief abstracts of a paper by PARSONS in the *Arena* for March.—He gives statistics in proof of the assumption that the Western Union Company defrauds the public by watering its stock; the present stock of $95,000,000 represents a total expenditure of $16,000,000, which added to $15,000,000 in bonds makes $31,000,000 as the actual cost of the system; he estimates that the actual value of the property is about $20,000,000, leaving therefore $5,000,000 as the value left for the stockholders; after paying interest on the bonds the public should not be asked to pay the stockholders more than 6 per cent. on $5,000,000; for 1895 it appears that there was a profit of $6,000,000 on less than $5,000,000 of property; it is thought that at least half the receipts were profit; the $6,000,000 have in large part been received by men who put almost nothing into the plant.

MISCELLANEOUS.

High-Voltage Currents and Water Jets. Lond. *Elec.*, May 1.—A note stating that Prof. Slavy, of Berlin, made an experiment to find whether a high-voltage alternating current can be sent from a conductor to earth by means of a jet of water from the hose of a fire engine and whether the current could thereby be transmitted to the firemen. A 10,000-volt power plant circuit was used for the experiment, a voltmeter being connected between the metal mouthpiece of the hose and the earth; on turning the water on to the three live conductors no flow of current to earth was noticeable. (No further information is given, and it is not stated whether the circuit was grounded at a second point; without further data too much reliance should not be placed on these results).

The Use of Lighting Circuits in Therapeutics. Meylan. *L'Elec.*, May 2.—An article describing an apparatus used with continuous-current lighting circuits for adapting the currents to therapeutical work; a battery of accumulators is used as an intermediary, and when the current is being used they are entirely disconnected from the circuit.

Lightning and Trees. Lond. *Elec. Rev.*, May 1.—According to a German journal, Mueller showed from statistics that in 11 years lightning struck 56 oaks, 3 or 4 pines, 20 firs, but not a single beech tree, although seven tenths of the trees were beech; it is therefore thought that in a storm it is safer to be under a beech tree than under any other.

Cost of Calcium Carbide. Hutchinson. *El'ty*, May 6.—A brief communication discussing the recent report of Houston & Kennelly (see *Digest*, May 2). He considers those tests very valuable, as they furnish the only well-authenticated data on the subject, but the assumptions made in the estimates he does not consider generally applicable; he thinks that the estimates are utterly misleading, and believes that the cost of the carbide will be at least $50 per ton at the factory, excluding all general expenses; this is borne out by the price in Europe, where the selling price is equivalent to $81.50 per short ton, which probably means a factory cost of $50. He gives various figures, which have been obtained by different authorities, for the power required to produce a pound of the carbide; he suggests that the report might have contained an estimate of the cost of making the carbide at Niagara Falls, where there is a factory, and where the conditions are definite and ascertainable.

Manufacture of Calcium Carbide. Dunlap. *West. El.*, May 16.—A brief, illustrated description of the plant at Niagara Falls. It is stated that at Spray the carbide is manufactured at $21.72 per ton, but in the plant described it is thought that this will be materially reduced; there are four furnaces, each intended to consume 500 horse-power and producing in one day about 2.5 tons of the carbide; single-phase alternating currents will be used.

Calcium Carbide and Acetylene and Their Applications. Hospitalier. *Prog. Age*, May 1.—A translation of the article noticed in the *Digest*, Feb. 22.

Action of Electric Currents on Mine-Surveying Instruments. Lenz. *Eng. & Min. Jour.*, April 18.—He made some experiments in a mine and found that magnetic observations can be satisfactorily conducted only during the night "in the absence of the magnetic current." Another source of error is the safety lamp, which in its hot condition is said to set up thermo-electric currents which act on the magnetic needle; experiments were made to show this.

Electrical Stage Effects. Waters. *Elec. Power*, May.—A profusely illustrated article describing and illustrating the numerous applications of electricity in producing stage effects.

Biographical. Elec. Power, May.—An article by Loewenthal on "The Mothers of Eminent Electricians," containing portraits and biographical notes. Another article on "Some Interesting Features," containing fac-similes of letters from prominent electricians and some biographical notes.

Biographical. Elec. Jour., April 15.—A full-page portrait of the late Von Helmholtz. The issue of May 1 contains a full-page portrait of the late Van Depoele, accompanied by a biography by Mr. Jannus.

Teaching—a Trade or a Profession? Shurman (Cornell University), *Forum*, April.—A general article on the subject of teaching and teachers, taken from a recent address before the National Educational Association.

New Book.

Ruhmkorff Induction Coils; their Construction, Operation and Application, with chapters on Batteries, Tesla Coils and Röntgen Radiography. By H. S. Norrie; 180 pp.; 57 illustrations; paper. Spon & Chamberlain, New York. Price, 50 cents.

Prof. Röntgen's discovery has awakened a very deep interest in the induction coil, which instrument had hitherto received little consideration at the hands of practical electricians. The Röntgen ray requirements, however, have brought the instrument to the front with a great bound, with the result that there is an abnormal demand for this interesting apparatus. Literature on the subject of induction coils is meagre and inadequate to the necessity of the times, so Mr. Norrie in this little work has endeavored to meet the call for more information on induction coils and their uses.

The title of the book explains its scope, and it at once strikes the experimentalist that such a work is what is eagerly looked for at the present time.

The contents of the book by chapters is as follows: Coil construction, contact-breakers, insulations and cements, condensers, experiments, spectrum analysis, currents in vacuo, rotating effects, gas lighting and ozone production, primary batteries, storage batteries and electric light currents, Tesla and Hertz effects, Röntgen rays and radiography.

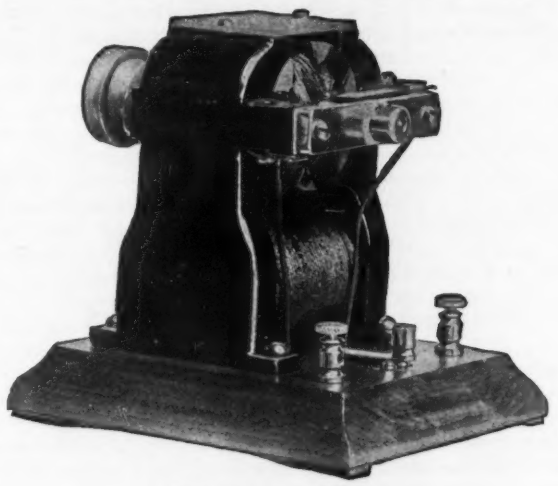
The work is written in a clear style and well-composed, and there is no doubt that it appears at a very opportune moment.

Self-Propelling Vehicles.

The Chamber of Commerce of Walsall, England, seem to have a preconceived dislike for horseless carriages. Among the provisions they wish to have introduced in any bill legalizing the use of these vehicles are these: Self-propelled vehicles to carry a red and a white light; their speed shall be limited to eight miles an hour in towns, and they shall carry a speed indicator so that there shall be no doubt about the speed at which they move; they must ring a bell continuously while in motion; they must stop whenever any one with a horse signals them to do so, and, finally, when used for hire there must be a "certificated" person in charge.

Small Dynamo and Motor.

The Kent Electric Manufacturing Company, Worcester, Mass., makes a small machine that can be used either as a dynamo or motor, and prove efficient in either capacity. It has a drum armature and runs very smoothly. As a dynamo the No. 3 machine will run three 8-cp 8-volt in-

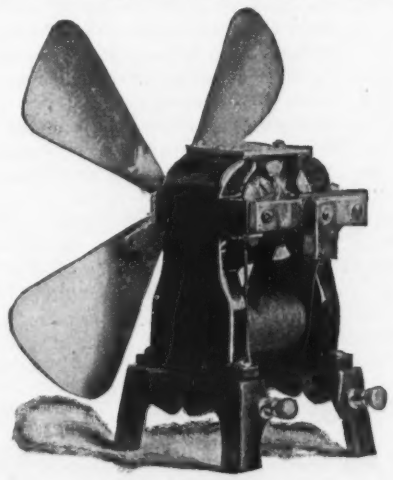


Dynamo and Motor.

candescent lamps, or it will run a similar machine as a motor. It is series-wound and builds up quickly.

On four cells of battery the motor will drive a sewing machine or perform other light work.

The bearings are self-oiling, and carry enough oil for a season's run.



Kent Fan Motor.

As a motor the machine, on four cells of battery, is capable of driving a 10-inch fan with considerable power.

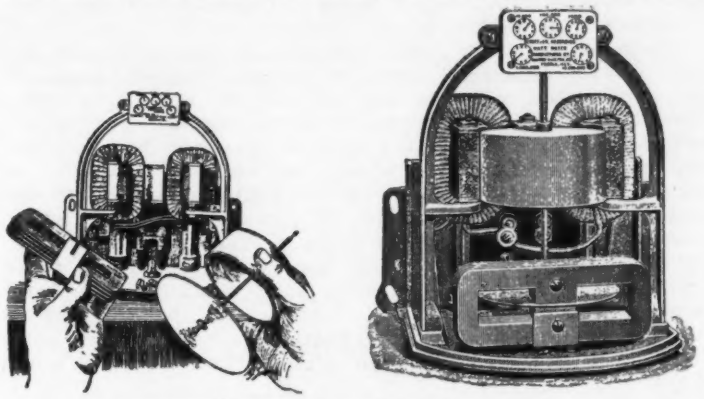
These machines are well made and finished, and the company claims that they are the only small ones on the market that will run efficiently as dynamo or motor.

Recording Wattmeter.

The accompanying illustration represents the Scheeffer recording wattmeter as manufactured by the Diamond Electric Company, Peoria, Ill. The meter has been thoroughly tested by Prof. D. C. Jackson, of the University of Madison, Wis., and the result of his test shows a remarkable performance of the meter from no load to full load and upon frequencies from 60 to 140 periods per second.

There is apparently no variation in its readings from zero to full load, showing that the meter is remarkably accurate, sensitive and reliable. Prof. Jackson says: "The test shows that the meter is remarkably accurate over its whole range of load, and is almost equally accurate on any frequency in commercial use from 60 to 140 periods per second. The meter starts promptly on loads of a few watts, and uses a negligible amount of energy. The inductive drop of pressure through the meter is very small."

The pressure upon which the meter is operated affects its accuracy to some extent, and the tests given here were made upon a pressure within



WATTMETER FOR ALTERNATING CURRENTS.

10 per cent. of that for which the meter was adjusted. Changes of 10 per cent. in the pressure do not interfere with the satisfactory commercial accuracy of the meter.

It will be seen that the meter is very simple in design and construction. All electrical points of contact are eliminated, thus avoiding a constant source of trouble.

As sent from the factory the meters are calibrated to such frequencies as are specified on the certificate sent with each meter. The meter may be corrected for frequency, and when so calibrated are unaffected by any frequency or wave form. The adjustment of the meter is easily effected by simply moving the dampening magnet.

As this meter has but little friction in its movements it is very sensitive and will start promptly on a two-cp lamp and measure the energy supplied.

Interior Telephones.

The Spencer Electric Company, 163 Greenwich Street, New York, is manufacturing a telephone for which it claims features of merit. The instruments are of new design and in very few respects resemble the old styles in appearance.

The instrument for interior work is simple in construction and design, and when wired for a metallic circuit all trouble due to induction is overcome. The operation of calling up the station desired is a very simple one and involves only one motion.

The desk telephone is very neat in finish and appearance, and the company claims that there is none better. It is well proportioned and well balanced, and all of the delicate mechanism is enclosed in a hard wooden case, neatly mounted on a metal base of unique design.

The instruments designed for apartment houses and hotels are substantially made and easily operated and will no doubt commend themselves to architects and builders.

The company makes a submarine telephone and is now equipping a diver's outfit with one of these instruments. This suit is to be used by W. J. Cummings, who is now engaged in submarine work. This telephone will enable Mr. Cummings to communicate with the surface from below. An exhibition of this application of telephony to submarine work will be given by Mr. Cummings.

The Spencer Electric Company's factory occupies an entire four-story building, and is provided with every facility for producing good and quick work.

New Electrical Manufacturing Company.

The H. P. Ball Manufacturing Company has just been organized in New York for the purpose of manufacturing electrical apparatus and supplies. Its products will include switches, switchboards, distributing boards, fuse blocks, spark coils, snap switches, etc.

Mr. H. P. Ball, the president of the new company, is well known in the electrical trade, having been for nearly 10 years connected with the General Electric Company in New York and Schenectady. The equipment of switchboards and appliances used in the United States Navy are of his invention and design, and he is also the originator of many of the railway and lighting appliances used by the General Electric Company.

For over two years Mr. Ball was superintendent of the Carpenter Enamel Rheostat Company, and was largely instrumental in bringing this company's goods to their present state of perfection.

The Ball Company is making a specialty of baby knife switches, which are said to differ from all others on the market. These switches are mounted on a large porcelain base, and are well made and finished.

The company's factory is situated at the corner of Pacific Street and Schenectady Avenue, Brooklyn, and its office is at 101 Beekman Street, New York.

Something New in Pliers.

The cutting pliers illustrated herewith are an improvement over the ordinary style. As will be seen they are made with a large hole to accommodate the insulation of large wires, thus avoiding all danger of injury to the same when cutting the wire.

Patterson Bros., New York, state that these pliers are solid cast steel

IMPROVED WIRE CUTTER.

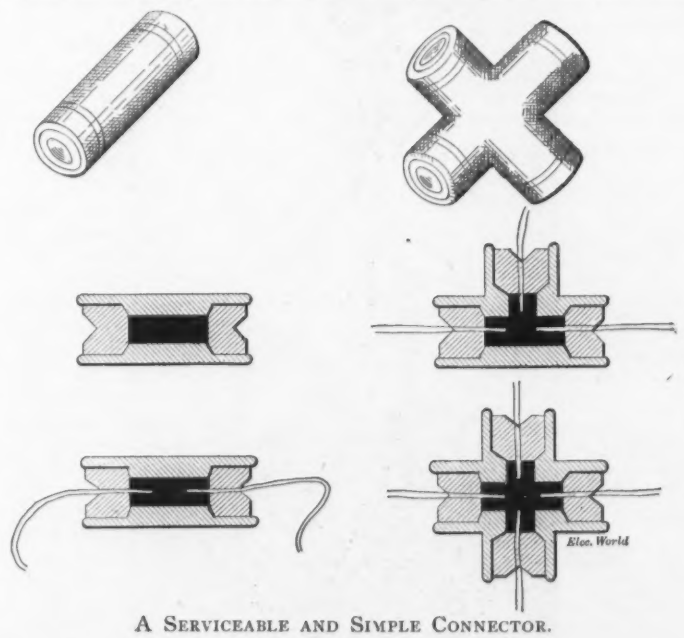
and of superior quality. They are known as the "Heart" pattern, from the stamp of a heart on each pair, and are made in five sizes from 5 inches to 8 inches.

New Electrical Connector.

The connector described below is designed to obviate some of the inconveniences of the ordinary connector.

It consists simply of an insulating material and enclosing a core of conducting amalgam (Hg).

It is cylindrical in form, and in each end is inserted a soft rubber stopper having a small hole in its centre through which a conducting wire can be inserted, thus making connection through the amalgam core.



A SERVICEABLE AND SIMPLE CONNECTOR.

It will be seen that the use of these articles must save a great amount of time in making connections for experimental purposes, as all that is necessary is to insert the conducting wires through the perforated stoppers, there being no screws to tighten.

Since the exterior of the apparatus is of insulating material (hard rubber), there is no danger of a "short-circuit" by the connectors coming in contact.

This system is applied to reversing switches and various instruments, and is the invention of F. E. Austin, Hanover, N H.

Insulator Support.

A simple, efficient and readily-adjustable insu'ator support is being placed upon the market by the Clarke Electric & Specialty Manufacturing Company, Minneapolis, Minn.

This insulator is designed for supporting on cross-arms overhead wires of all kinds, and its construction is such that the usual boring of holes in the cross-arms for insulator pins is entirely done away with. As will be seen from the illustration, Fig. 1, the insulator support consists of a yoke adapted to embrace the cross-arm, and provided at the lower end with bolt and nut to tighten the device in place.

This support can be adjusted to the cross-arm at any desired point and

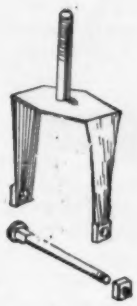


FIG. 1.

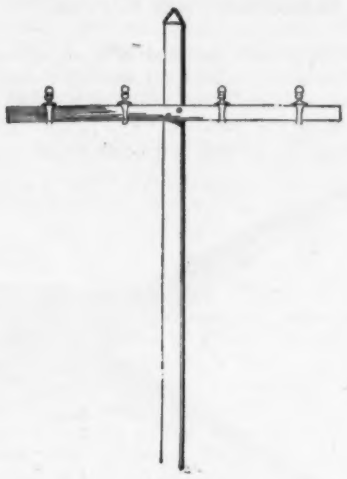


FIG. 2.

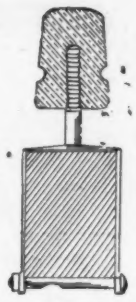


FIG. 3.

rigidly clamped in position. Since by its use it is not necessary to bore holes in the cross-arms the life of the latter is greatly prolonged. One of the causes of the deterioration of cross-arms is the decay brought about by the action of the water and moisture getting into insulator-pin holes.

Another advantage this support offers is that smaller cross-arms may be used, for the reason that a relatively smaller one without holes will have as great strength as a larger one bored with holes for the old style insulator.

DESK SET.

The support can be quickly and conveniently applied or removed, and where there are more wires on one side of the pole than on the other, an efficient balance can be easily effected by re-adjusting the supports.

Fig. 2 shows four supports clamped to a cross-arm, and Fig. 3 gives a cross-sectional view of a cross-arm and clamp.

The M. & B. Transmitter.

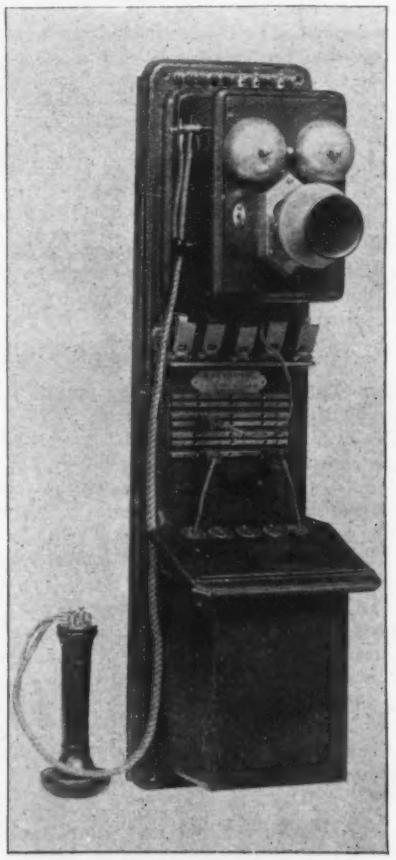
That there is a wide and profitable field for the employment of capital in competing for telephone business is evident by the large number of so-called independent telephones that have been offered for public favor. The great obstacle to independent action and competition in the telephone field at the present time is the Berliner patent, which is now in litigation, pending the decision of a suit in the United States Supreme Court. This patent is so broad that it has had the effect of excluding the use of competing battery transmitters. The United States Telephone Construction Company, of Philadelphia, however, claims that its Make and Break (M. & B.) transmitter is absolutely non-infringing and guarantees perfect immunity from legal complications to those who use the instrument.

The M. & B. transmitter is unlike any other. The diaphragm has attached to its centre a small aluminum cup holding a carbon or other suitable point. In front of the rubber shell is a basket or runway of aluminum and in this lays normally a carbon ball eleven sixteenths of an inch in diameter. The aluminum basket is so constructed that no matter which side of the transmitter is up, the sphere rests upon a plane which is always inclined toward the diaphragm. By this construction the point on the diaphragm comes on a level with the centre of the carbon ball which is kept against this point by gravity. There is sufficient space between the back of the basket and the diaphragm to allow the carbon ball a maximum movement of nearly one sixteenth of an inch and it is said that with every vibration of the diaphragm, the movement of the carbon sphere breaks the battery current, whence comes the name, Make and Break, given to this particular instrument. The features claimed for this transmitter are clearness of articulation, great volume of sound without any sputtering or similar disadvantages, long-distance transmission and simplicity of construction. Another peculiarity of the M. & B. telephone is its ability to overcome induction which is the result not of any special device, but of the conformation of the transmitter.

The United States Company manufactures six standard styles of instruments which cover the entire requirements of the business, namely, No. 1, for long distance and trunk line service, and guaranteed for 1000 miles; No. 2, standard exchange 'phone for exchange work in towns and cities, also for private lines. No. 3, station telephones with switchboard attachments for 20 connections or less; No. 4, interior sets for hotels, factories, public buildings, etc., with intercommunicating connections where required and with magneto or battery call; No. 5, magneto call set same as the exchange telephone, but without backboard and battery box; No. 6, desk sets for offices, etc. The company also manufactures switchboards of its own design that are claimed to be non-infringing in every detai and adapted to every descripl tion of exchange work.

Written opinions of leading patent lawyers on the M. & B. telephone demonstrate that it is unassailable and in nowise an infringement on the Bell Company's instrument.

MAGNETO CALL SET.



STATION TELEPHONE.

The M. & B telephones are made with the greatest care and under constant expert supervision. They are both durable and reliable and maintain their qualities of excellence through a long period of service.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, May 16, 1896.

EDISON ILLUMINATING COMPANY.—The earnings of the Edison Electric Illuminating Company of New York for April, 1896, and for the first four months of the year, as compared with the earnings during the same periods last year, are shown in the following table :

	1896.	1895.	Increase.
Gross	$180,110.64	$163,410.74	$16,699.90
Net	90,584.30	77,685.75	12,898.55
Gross, four months	777,670.05	712,452.28	65,217 77
Net, four months	399,368.68	342,582.25	56,786 43

ELECTRICS.—General Electric stock was featureless, fluctuating in a very narrow margin. The highest price obtained during the week was 34⅝ and the lowest 33½, closing at 33¾. The preferred suffered a loss of a point on the week's transactions. Westinghouse common remained steady, the preferred, however, losing a ½ point.

TELEGRAPHS.—Western Union remained steady during the week. The range of prices was between 84⅝ and 85⅜, and transactions were normal.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	97	99½
" " " Brooklyn	100	100	102½
" " " Boston	100	135	140
" " " Philadelphia	100	137	..
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	35	35¼
Electric Storage, pref	100	36¼	37¾
General Electric	100	33⅝	34
General Electric, pref	100	73	74
Westinghouse Consolidated, com	50	29	30
" " pref	50	52½	53
BONDS.			
Edison Electric Ill., New York	105	103	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	206	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	205	206
American District Telegraph	100	38	40
American Telegraph & Cable	100	91	95
Central & South American Telegraph	100	124	127
Commercial Cables	100	150	..
Erie Telephone	100	58¾	60
New England Telephone	100	..	90
Postal Telegraph-Cable	100	85	87½
Western Union Telegraph	100	84½	84¾
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18¼	18½
Brooklyn Rapid Transit		23½	24¼
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	70	73
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	44	47
Hestonville	100	50¼	50½
" pref		..	62½
New Orleans Traction	100	13	16
" " pref	100	57	60
North Shore Traction	100	29	31
" " pref	100	79	81
Rochester St. Ry	..	20	25
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	14½	14¾
West End, Boston	100	72	..
" " pref	100	92	..
Worcester Traction	100	16½	18½
" " pref	100	86	89
BONDS.			
Brooklyn Rapid Transit 5s. 1945	100	78	80
Buffalo St. Ry. 1st con. 5s	100	106	..
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	95	100
Rochester St. Ry. 1st 5s	100	99½	102
Union Railway (Huckleberry) 1st mtge 5s		102½	105
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

TRACTIONS.—There was a very small demand for traction stock, and the amount that changed hands was less than for any week for some months past. This inactivity and lack of demand resulted in a general decline in a majority of the issues.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, May 18, 1896.

NEW YORK, N. Y.—The main lighthouse on Sandy Hook and the West Beacon lighthouse at the same point were lighted by electricity for the first time on the night of May 9.

DEATH OF MR. DE LA VERGNE.—John C. De La Vergne, president of the De La Vergne Refrigerating Works, Morrisania, died on May 13, at his home in this city, of general debility.

PRACTICAL SCIENCE.—We have received a bound copy of the papers read before the Engineering Society of the School of Practical Science at Toronto. It includes some interesting matter.

CROOKES TUBE.—We have received a copy of a paper read by Francis E. Nipher before the Academy of Science, of St. Louis, May 4, entitled, "On a Rotational Motion of a Cathode Disc in the Crookes Tube."

REDUCTION IN PRICES FOR CARBONS.—The General Incandescent Arc Light Company, New York, of which Mr. R. B. Corey is general sales agent, announces a reduction of 25 per cent. in its imported "Sun-Schmelzer-Nuernberg Carbons." This reduction went into effect on May 1.

MR. D. S. HOLCOMB has moved from his old stand at 48 Dey Street to larger quarters, at No. 51 Dey Street, where he will have better facilities for carrying on his business. Mr. Holcomb is a practical electrician, and makes a specialty of repair work on armatures, field magnets and commutators.

MR. FRANCIS JEHL.—A subsequent note from this gentleman in regard to his departure for Vienna, whither he has been called by F. Hardmuth & Co., whom he represented in this country, states that the business, during his absence, will be looked after by Messrs Machado & Roller, 203 Broadway.

RÖNTGEN-RAY APPARATUS.—Mr. J. A. Le Roy, 143 East Thirteenth Street, is making portable Röntgen-ray outfits, which, no doubt, will be interesting information to those who desire to carry on experiments in this line. The outfits are complete, and include everything necessary to produce the rays; also a fluoroscope.

CONVENTION VISITORS.—Among those who attended the recent convention was Mr. Albert Smith, of the firm of Keelyn & Smith, of Milwaukee, Wis. Mr. Smith was favorably impressed with what he saw and heard. He is on a pleasure trip of several weeks duration, and will visit Washington and Niagara Falls before his return home.

OBJECT TO RAILWAY STABLES.—West side residents are protesting against the leasing of two lots on Seventy-sixth Street and the Boulevard by the Boulevard Street Railway Company for stable purposes. The stables are in the residential quarter. The railway company announces its intention to maintain the stables regardless of the protests.

THE GOUBERT MANUFACTURING COMPANY, New York, has opened a Western office at 1403 Monadnock Block, Chicago. Mr. E. Webster, a gentleman well-known in engineering circles and expert in the matter of steam appliances, will be in charge of the Western office. Mr. Webster was for many years connected with the Stilwell-Bierce & Smith-Vaile Company.

RIVAL UNIONS OF ELECTRICAL WORKERS.—Local Union No. 3 of the Brotherhood of Electrical Workers, K. of L., and local Union No. 5 of the National Brotherhood of Electrical Workers A. F. of L. are at loggerheads and strikes on different buildings are threatened by the members of one union because of the employment of members of the other union on the same work.

LIGHTING THE BRIDGE.—The bill providing that incandescent lamps of not less than 30 candle-power each shall be placed on each side of the Brooklyn Bridge, along the entire length of the railway tracks, at intervals of not less than 50 feet, and that these lights shall be lighted during foggy weather, was before Mayor Strong last Wednesday for a hearing. No one appeared in favor of the bill, and the Mayor signified his intention of disapproving it.

PORTABLE ELECTRIC PROPELLERS.—Mr. Frank S. Allen, 136 Liberty Street, states that during the past Winter he has made shipments of portable electric propellers to Florida, England, Denmark, Sweden, Finland, Italy and France, and his correspondence on the subject extends to the Cape of Good Hope, North Russia and North and South America. This propeller can be readily attached and detached, and combines in one propeller, rudder and motor—the whole thing weighing only 35 pounds. Boats equipped with this outfit can go in the shallowest as well as deep water.

WASHINGTON NOTES.

WASHINGTON, D. C., May 15, 1896.

WAITING STATIONS are being erected by the Falls Church Electric Railway Company, one of which is located at Arlington, and the other on the Virginia side of the river at the Aqueduct bridge. The structures will cost about $1000 each.

THE HOUSE OF REPRESENTATIVES, in putting a time limit of 12 months to complete the road of the Capital Company, appears to have done an injustice. The charter with the House amendment compels the company to build the whole road in 12 months, or forfeit the entire charter. If 10 miles of road are built and one is unbuilt the whole franchise is forfeited. The company is required to build an underground electric road on a drawbridge which is an experiment. The road is too much needed to endanger building it by limiting the company to an unreasonable time. The amendment, as reported by the conference committee, was not for the benefit of the Capital Railway, but evidently intended to kill the bill, or help other roads.

THE POTOMAC LIGHT & POWER COMPANY is to be prevented from stringing any more overhead wires in the District of Columbia. The minority report of the Senate District Committee on the measure practically chartering this company has brought this about. The report is one of the tartest documents introduced in the Senate for a long time. The most sensational part of the report refers to the sale of the Eckington electric light plant. The broad, plain statement is made that Commissioner Truesdell sold it to the promoters of the Potomac Power & Light Company, and then that the Commissioners at once granted permits to the company to erect poles and string wires. Senator Gallinger introduced a resolution in the Senate last Winter directing the Commissioners to furnish information concerning the permits granted to electric light companies and other companies for the stringing of overhead wires. After waiting a month the Commissioners reported that four permits had been granted. As matters now stand the decision of Judge Bingham prevents the Commissioners from granting permits, and declares those granted illegal. In simple terms, the decision is that the Commissioners, as the successors of the old board of public works, have no right to grant anybody a franchise. The present cause of excitement is an amendment to the district appropriation bill, which authorizes the erection and use of poles for "telephone and other purposes." The objection to the amendment is that on the face it is innocent, but that it conceals altogether too much, the clause "and for other purposes," lets in everything. The most startling portion of the amendment, however, is the clause, "and the permits for this purpose heretofore granted are hereby ratified." This provision makes legal all the unlawful permits granted by the Commissioners in the past four years By the present unusual proceedings the Commissioners are made the judge of all things, and with no one to judge the Commissioners. The amendment practically gives them plenary powers. Senator Gallinger states that the bill will be defeated in the Senate. Meanwhile a lively fight is on.

THE COLUMBIA & WASHINGTON ELECTRIC RAILWAY COMPANY which is constructing an electric line between Washington and Baltimore, has, it is understood, secured an option on one of the most desirable pieces of property in the latter city, upon which it is said to be the intention of the company, if the deal is completed, to erect a building for its general offices, and as the terminal station for the northern end of the line. This property is at the corner of Howard and Saratoga Streets. As the three companies named own every street-car line in Baltimore, and the Columbia & Maryland Company either has already made, or has reason to believe it will be able to make, the most liberal transfer arrangements with them for the accommodation of its passengers, it is within the bounds of probability that in the course of a few months a person can take a Belt Line car here, transfer to a train of the Columbia & Maryland line and go to any part of Baltimore, returning the same way, for the one fare, which, it is understood, will not be more than $1.25 for the round trip. Work on different portions of the route, principally those near Baltimore, has been in progress for some time, and between Baltimore and Ellicott City the grading is about completed. Work on what is known as the main line, between the junction with the Ellicott City branch, not far from Catonsville and Laurel, is expected to be begun this week, and will be pushed to a finish as quickly as possible. Although the building of this road is expected to occupy such a short time as to cause marvel on the part of other railway contractors, there is no doubt that the roadbed will be fully up to the standard of the best steam railways in this or in any other country. Indeed, this is a matter of absolute necessity for safety, as it is said to be the intention of the managers of the road to offer such inducements in the way of quick transit between the two cities as to either draw largely from the numbers who now use the Baltimore & Ohio and Baltimore & Potomac trains for traveling to and from this city, or else induce a great many who have heretofore seen the attractiveness of both places to avail themselves of the opportunities. While there is still a vast amount of detail to be arranged, it is stated by one of the officers of the company that "the cars will be 43 feet long, heavier and more substantial than any now in service, and intended to make very fast time. They will be headed and lighted with electricity, fitted up in the style of a first-class day coach of a steam railway with air brakes and propelled by the overhead trolley system (outside the city of Washington) unless, perhaps, some experiments which are now being made, lead to the substitution of some other motive power. The through cars which will leave Washington and Baltimore every half hour will be run in trains of two, a motor and a car. The motor will have a baggage compartment, and will seat 32 persons, while the trailer will be the parlor coach, and will seat 42 passengers. On the accommodation trains between the cities these cars will run singly, starting at the quarter hours. The through trains will stop at the principal stations only, while the accommodation cars will stop at all the stations. There will be 26 of these cars in all placed upon the line as soon as it is opened. Each car will be fitted with double trucks, and on each of the axles there will be a 100-hp motor, geared for speed. This will give 400 horse-power per car, or four to eight times as much as the ordinary street car. For the local traffic from Washington to Laurel and for the Baltimore & Ellicott City branch the regulation electric street cars will be supplied. They will be 28 feet long, and of the latest and most approved pattern. It is the intention of the company soon after the road is opened for traffic to fit up parlor cars with movable chairs for the use of theatre parties between Washington and Baltimore. The managers of the new railway do not comtemplate any difficulty in the way of running the cars between the two cities in an hour, and it is believed that much faster time has been made by electric cars under conditions not nearly so favorable for the accomplishment of speed. It is predicted that it will not be long after the Columbia & Maryland electric road is open before express trains will be run between Washington and Baltimore in 45 minutes.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., May 15, 1896.

ENGINEERS' YEAR BOOK.—The University of Minnesota has issued its Engineers' Year Book for 1896. It has 130 pages and contains some excellent articles by well-known writers.

UNIVERSITY OF WISCONSIN.—This institution has issued a bulletin entitled "Electrical Engineering in Modern Central Stations," by Louis A. Ferguson, special university lecturer.

THE ELECTRIC APPLIANCE COMPANY'S complimentary duplicate order book advertising scheme has proven to be a big success and the books are much appreciated by their customers. The Electric Appliance Company still has a number of books left which will be sent free on application.

LAFAYETTE, IND.—The City Board of Assessments for railway, telephone and telegraph lines has assessed the Western Union Telegraph Company $100 per mile for the first two wires and $12.50 for each additional wire; the Great Southern Telephone & Telegraph Company, $30 per mile; and Teche & Vermillion Telephone Company, $15 per mile

THE "MERCURY" PULLEY COVERING COMPANY, 329 Prospect Street, Cleveland, O., is doing a large business with its pulley covering. As the covering becomes better known in the electrical industries the better it is appreciated. The Johnson Company, Lorain, O, covered a dynamo pulley with "Mercury" covering recently, and the result was so successful that instead of waiting for the expiration of the 30 days' trial, the company gave the order to cover every pulley in the generating plant. The entire equipment was completed within 20 days from the time of the first trial order. This covering is said to prevent slipping of belts, and slipping of belts on dynamos and generators means a good deal.

CANADIAN NOTES.

(From Our Own Correspondent.)

MONTREAL, Can., May 14, 1896.

STERLING, ONT, will soon be lighted with electricity.

BEETON, ONT., is to have electric lights at once, if enough subscribers can be had. Mr. Fletcher, of Allison, Ont., will put in the plant, and J. L Hamilton will supply power.

SANANOQUE, ONT —The Electric Light Company at Sananoque, Ont., will put in two new dynamos.

KASLO, B. C., is determined to have a water-works system, and is also negotiating for an electric light plant.

MAGOG, QUE., is prepared to receive tenders for lighting the town by electricity. Water-power can be had from the Dominion Copper Mills Company here.

NIAGARA FALLS, ONT.—The Niagara Falls Electric Light & Power Company, of Niagara Falls, Ont, has awarded the contract for a 5000-light incandescent plant to the Canadian General Electric Company, Limited.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, May 6, 1896.

GAS ENGINE CENTRAL STATIONS.—Some three or four years ago there threatened to be a boom in gas engine central stations. Several were actually started, and these have now, one and all, either actually stopped or are in progress of extinction. The last one to go is the station, or rather the series of sub-stations of Belfast. The Town Council has now decided to erect a steam generating plant sufficient to supply the whole of the city, and to have done with "toy stations."

STEEL STEAM PIPES AND BENARDOS ARC-WELDING.—At a meeting of the Institution of Mechanical Engineers on Friday last, a paper on "Steel Steam Pipes and Fittings and Benardos Arc-Welding in Connection Therewith," was read by Mr. Samuel McCarthy, an engineer who has charge of the electric welding department of Messrs. Lloyd & Lloyd's tube and pipe manufactory. In the paper the author described the application of the Benardos process to flanges and steam pipes, and to the jointing of several pipes together. As regards the manufacturing of the pipe itself it has been found, he stated, that electric welding is not so cheap nor so convenient as either roll welding or gas welding in welding a seam. The paper is accompanied by a number of tables giving the results of tests carried out by Messrs. David Kircaldy & Son upon samples of electrically welded bars, but no tests are given of the finished electrically welded steam pipes. During the discussion it was alleged that the Benardos process results in a brittle and sometimes a burnt joint being produced, and one speaker stated that the result was not welding at all, but a form of soldering or merely melting the surfaces together. In his reply, the author defended the electric-welding process against these charges, and said that electrically welded joints were as perfect as those produced in any other way, and would stand equally severe tests.

RECENT IMPROVEMENTS IN RAILWAY TELEGRAPHY.—A paper on "Railway Telegraphs with Special Reference to Recent Improvements," was

read by Mr. W. Langdon, of the Midland Railway Company, before the Institution of Electrical Engineers on Thursday last. The paper described the progress in construction work which has been made, and especially in the substitution of copper wire for iron and in the use of iron-armored poles. With regard to the instruments in use Mr. Langdon stated that in telegraph message instruments the vertical single needle remains generally used in Great Britain. For some years it has been the practice of the Midland Company to employ at the transmitting or terminal station single needle circuits with a Bright's bell, this arrangement being found to aid despatch and to lighten the labor of the clerk. The Bright's bell is also used on other lines. The sounder is very generally employed in Ireland, but very little in this country. There has been practically no demand for quadruplex working, with the single exception that it is employed between London and Harwich. Duplex working is very extensively employed on a large number of trunk lines. On the Midland, the duplex between Derby and London is arranged for a phonopore communication. The phonopore is also employed to a limited extent on the Great Western Railway Company, Great Eastern Railway Company, North British and other lines. With regard to interlocking apparatus, Mr. Langdon thinks that two important improvements will have to be effected. Firstly, that the signalling apparatus shall be entirely interlocked with the switching apparatus, and, secondly, that instead of the front coach of the train releasing the interlocking, this should always be effected by the rear coach. As long as the interlock is released by the front coach there is the standing danger of a detached portion of the train remaining on the line without any warning being given at the signal box or without any effect on the interlock itself.

A PERMEABILITY BRIDGE.—At the Royal Society soiree last year Prof. Ewing exhibited his ingenious hysteresis meter, by which, as no doubt many of your readers will recollect, the rotation of a sample of iron by means of a handle between the poles of a permanent magnet, caused an index to deflect along a scale from which the investigator read off directly the hysteresis value of the sample. This year Prof. Ewing exhibits another device for shortening the labors of those engaged in testing the magnetic properties of iron, a device scarcely less ingenious than his hysteresis meter. The principle of Prof. Ewing's new apparatus, which he calls "a permeability bridge," is to compare the sample to be tested step by step with a standard bar, the BH curve of which has previously been determined once for all. Two bars, namely the standard and test bars, are slipped into two parallel magnetizing coils. They are next joined to short yokes of soft iron. From the yoke two long horns project upward, which nearly meet above, and in the gap between the two horns, a box containing a compass needle is placed. When the two yokes are at the same potential difference, that is to say, when there is no induction across from yoke to yoke through the two iron horns, a condition which is produced only when the magnetic induction in the two bars is the same, the needle will not deflect, the lines that go from right to left over one bar, returning from right to left along the other. If both bars have the same permeability, this state of balance will be produced by having the same number of ampere-turns, but if the permeability differs, this condition can be produced by altering the relative number of ampere-turns. To do this the number of effective turns in the magnetizing coil of the sample or test bar is altered by means of dial switches, the same current passing through both coils in succession. To get rid of the effects of hysteresis a reversing key is fitted with the apparatus and is worked as the adjustment proceeds. To prevent the current from altering when a balance is being obtained, the dial switches are furnished with a second set of contacts, which throw in compensating resistance as the number of turns in the magnetizing coil is reduced, so that the total resistance of the circuits remains unchanged. The clear length of each bar is 12 56 centimetres (4π) and the number of turns in the magnetizing coil of the standard bar is 100. Hence the magnetizing force due to this coil is 10 C. G. S. units for each ampere. This allows any required magnetizing force to be easily applied with the aid of an amperemeter and an adjustable resistance outside the instrument. A knowledge of the current determines the value of H on the standard bar, and hence B, the relation between B and H being known. A knowledge of the value of the current and the number of turns on the test bar also gives the value of H for it, and a balance has been obtained on the instrument, since the value of B in the test bar is the same as that in the standard. Hence we can determine the value of μ for the sample, for the particular value of B, and so on for all values.

MUNICIPAL ELECTRIC LIGHT AND TRACTION ENTERPRISE.—It would certainly seem from the reports that have lately come in from all parts of the country, that before many years are over our heads nine out of every 10 electric lighting and traction enterprises in this country will be in the hands of the municipal authorities. The following is a sample week's news: The Bristol Town Council has decided to increase the capital outlay of its electric lighting undertaking to £175,000. The sum originally raised amounted to £65,000. It is expected that when the additional sum has been spent, the station will be able to cope with a load of 40,000 8-cp lamps. I may mention in this connection that there has been a determined effort on the part of a section of the Bristol Town Council to force the local tramway company to take its supply of current from this extended station. Hitherto the tramway company has offered strenuous opposition to this suggestion on the ground that it does not do to have divided authority in a big tramway undertaking. Indeed, the chairman of the company has gone so far as to say that if the Town Council insists upon this proviso, he will advise the shareholders to retain horse traction until the expiry of the company's lease.——At the Manchester Corporation to-day a resolution will be brought forward in favor of expending £100,000 in extending the electric lighting undertaking of that town, which, I may mention, is on the five-wire system.——The Canterbury Town Council decided on Saturday to adopt a municipal electric light scheme, and proposed to raise a loan of £20,000 for that purpose. It is expected that the celebrated cathedral will be one of the first buildings to be illuminated by electricity.——York, the capital of our archbishopric, has also decided "to go in for electric lighting," but is apparently in favor of doing so indirectly, that is to say, in favor of leasing its powers for a period of years to a company.——The Lancashire manufacturing town of Bolton has decided that it is desirable that the overhead trolley system of electric traction should be adopted for the working of the corporation tramways.——The historic watering-place of Bath has also been bitten by the prevailing mania, and that notwithstanding the fact that an enterprising little pioneer company has catered for its electric lighting necessities in an excellent manner for several years past To this company small mercy is to be meted out. It was weak enough to commence the undertaking on the strength of a seven years' license, hoping that when the seven years' period came to an end, the corporation would offer no opposition to the license being transformed into a provisional order, *i. e.*, a franchise lasting, in the ordinary course of things, 42 years. The company, however, counted without its host. When it applied for a provisional order, the Bath Town Council offered vigorous opposition and finally forced the company to submit to an award of an arbitrator appointed by the Board of Trade. This arbitrator, Mr. A. B. W. Kennedy, one of the most eminent consulting engineers in the electrical profession, has not been able, under the terms of the arbitration, to award the company a larger sum than £26,500 for its lands, buildings, plant and mains, on which it has spent the sum of over £38,000. This is another instance of the determination of Town Councils not to pay one penny piece more for an electrical undertaking than they are obliged by the strict law of the land.

General News.

NEW INCORPORATIONS.

THE PAWTUCKET ELECTRIC COMPANY, Pawtucket, R. 1., has been incorporated with a capital stock of $600,000.

THE WAYNE COUNTY TELEPHONE COMPANY has been organized in Fairfield, Ill., with a capital of $25,000. Incorporators, Edwin E. Cribs, C. M. Breck and D. P. Moore.

THE HOME TELEPHONE COMPANY, of Greenville, S C., has been incorporated with a capital stock of $4000. The incorporators are George Browning, Julius C. Smith and D. P. Conyers.

THE BANKERS' ELECTRIC PROTECTIVE COMPANY has been incorporated at Chicago, Ill., with a capital stock of $150,000. The incorporators are A. L. Deane, J. W. Donnell and Clyde J. Coleman.

THE ELECTRIC SPECIALTIES COMPANY, San Francisco, Cal., has been organized with a capital stock of $100,000, by A. C. Robbins, C. P. Visher, George T. Burtchaell, Daniel Crowley and D. F. Jones, Oakland, Cal.

THE CARSON HILL POWER COMPANY, San Francisco, Col., has been incorporated by James H. Cutter, James E. Baker, J. P Rothwell, J. E. Godley, San Francisco, and S. B. McNear, Oakland, Cal. Capital stock, $100,000.

THE SOLANO ELECTRIC LIGHT & GAS COMPANY, Benicia, Cal , has been formed with a capital stock of $100,000 by Thomas McKay, J. Kullman, G. A. Hastings, S. Frame and George Frame, Benecia, Cal. Capital stock, $100,000.

THE CENTRAL ELECTRIC MANUFACTURING COMPANY, Tacoma, Wash., has been formed with a capital stock of $50,000. The incorporators are E. E. Salisbury, A. E. Dean, W. K. Wright, F. B. Taylor and H. E. Wright.

THE AMERICAN ELECTRICIAN COMPANY, New York, N. Y., has been organized with a capital stock of $50,000. The incorporators are W. D Weaver, New York City; Edward Caldwell, Plainfield, N. J., and Elmer E. Wood, Brooklyn, N. Y.

THE ATLANTIC COAST ELECTRIC LIGHTING COMPANY, Asbury Park, N. J., has been incorporated with a capital stock of $500,000, by John E. Comins, Arlington, N. J., Arthur D. Chandler, Orange, N. J., and John B. Summerfield, Brooklyn, N. Y.

THE SUSSEX ELECTRIC RAILWAY COMPANY has been organized to construct a street railway from Milford to Lewes by way of Milton. The incorporators are William B. Tomlison, William T. Parker, Dr. James A. Hopkins and John C. Hazzard.

THE BAY STONE MINING COMPANY has been incorporated with a capital stock of $500,000, at Spokane, Wash., for the purpose of doing a general mining and electric light business. The incorporators are M. J. Reddy, C. J. Reiner and Michael O'Shea.

THE GENERAL CONSTRUCTION COMPANY has been incorporated at Boston, Mass., by Henry W. Burgett, James W. Longstreet and John J. Henry for the purpose of constructing railways, electric and gas plants, water works and telephone and telegraph lines. Capital stock, $30,000

THE CALIFORNIA MINING & POWER COMPANY, Haverly, Col., has been incorporated for the purpose of constructing street car lines, telephone and telegraph lines, and engaging in other enterprises. The promoters are James H. Myers, J. H. Haverly, and J. S Davis, Denver, Col. Capital stock, $300,000.

THE SPOKANE COPPER MINING & SMELTING COMPANY, Spokane, Wash., has been organized by J. E. McCall, F. Mallery, M. Monroe, Maurice Vetter, P. Gilbert and W. S. Dawson, for the purpose of doing a general mining, smelting and electric light business. Capital stock, $1,000,000.

THE BEACON ELECTRIC LIGHT COMPANY has been organized in Lansingburgh, N. Y., with a capital stock of $100,000. The incorporators are William M. Lee, Samuel Bolton, Jr., and Edward Van Schoonhoven, of Lansingburgh; E. B. Ellicott, and J. W. Ebert of Chicago, and Albert Will and J. G. Kaelber, of Rochester.

THE ELECTRIC POWER & CONSTRUCTION COMPANY, Camden, N. J., has been incorporated with a capital stock of $100,000 to buy, sell, lease and build electric light and power plants. Those interested are Dr. Abel T. Bruere, Trenton, N. J.; William H. Macdonald, Philadelphia, Pa., and Arthur W. Middleton, Oxford, Md.

THE NUNGESSER ELECTRIC BATTERY COMPANY, Cleveland, O. has been incorporated with a capital stock of $10,000, for the purpose of manufacturing and dealing in primary and secondary electrical batteries, electrical goods and supplies. Those interested are: P. P. Nungesser, Arthur B. Foster, M. M. Hobart, Richard Bacon and F. P. Beecher.

THE ETNA & MONTROSE RAILWAY COMPANY, capitalized at $60,000, has been incorporated at Harrisburg, Pa., to build a line from the mouth of Pine Creek to Montrose, a distance of six miles. President, George A. Chalfant, of Etna. Directors, Hugh Kennedy, James R. Davragh, Sharpsburg; George B. Painter, Jr., and W. C Steele, of Allegheny.

THE ELECTRIC CARRIAGE & WAGON COMPANY, New York, N. Y., has been organized for the purpose of making and selling all kinds of vehicles including automobile vehicles adapted to propulsion by electric storage batteries or other mechanical means. The incorporators are: William Halls, Jr., R. B. Hartshorne and I. L. Rice, New York City. Capital stock, $300,000.

THE NOTI INSULATOR COMPANY, New York, N. Y., has been formed with a capital stock of $25,000, for the purpose of manufacturing and selling glass and porcelain insulators for electric railways, electric light, telephone and telegraph. The incorporators are Albert Vickers, New York City; William Debb, Henry S. Newton and William Blackwood Smith, Syracuse, N Y.

THE ST. LOUIS & DENVER LEFFLER ELECTRIC MAGNETIC RAILWAY COMPANY, Kansas City, Mo., has been incorporated in West Virginia for the purpose of building railways, highways, subways, etc. Those interested are: Frederick J. Patterson, Chicago, Ill.; Lester T. Sunderland, Omaha, Neb., and J. F. Shatts and W. H. Ferguson, La Crosse, Wis. Capital stock, minimum, $1000; maximum, $5,000,000.

THE HIGHLAND SCENIC RAILWAY COMPANY has been organized in Brentwood, Mo., with a capital of $150,000. The company is incorporated by James D. Houseman, Jr., Ernest Marshall, J. I Broderick, L B. Jones and W. F. Richards, to build, equip and operate a standard-gauge railway near the Manchester Road, to a point on the Manchester Road Electric Railway, where the latter crosses the city limits of St. Louis, a distance of about two miles; also to operate a railway from Meramee Highlands to the eastern terminus of the St. Louis & Kirkwood Railway, near the southwest corner of Forest Park, in St. Louis, a distance of about 10 miles. The road is to be operated by electricity.

TELEGRAPH AND TELEPHONE.

TUSCOTA, ILL.—Tuscota is to have a telephone exchange.

DECORAH, IA.—The new telephone line between this place and Freeport is finished

MARSHALLTOWN, IA.—A telephone line is being established from State Centre to Melbourne.

HONESDALE, PA.—The Citizens' Telephone Company are at once to extend its line to Tanner Falls.

PITTSBURG, KAN.—The Phœnix Telephone Company has been purchased by G. C. Lofland, of Topeka.

KANSAS CITY, MO.—The long-distance telephone line between this city and Omaha has been completed.

CORNING, IA.—A telephone exchange is to be established in this city by the Iowa Union Telephone Company.

CURWENSVILLE, PA.—A new telephone line will be erected from Curwensville to Patton, Hastings, Spangler and Barnesboro.

SIOUX FALLS, S. D.—A telephone line is to be constructed from this place to Parker. At Parker it will probably be connected with the one running to Elk Point.

ST. LOUIS, MO.—It is expected that the long-distance telephone line between Chicago and St. Louis will be completed in time for the Republican National Convention.

BROOKLYN, N. Y.—The New York & New Jersey Telephone Company will erect a 10-story building on the corner of Lawrence and Willoughby Streets, at a cost of about $275,000.

EDINBURG, IND.—The Citizens' Telephone Company, of Edinburg, proposes to operate telephone lines in Johnson, Shelby, Bartholomew and Brown Counties Its capital stock is $1200.

LANCASTER, WIS.—The Crawford and Grant telephone companies are both extending their lines to Bridgeport, where they will join in a common line for communication over both systems.

FORT DODGE, IA.—E. H. Martin, of this place, is prominent in connection with the organization of the Fort Dodge Telephone Company. The company is composed of Fort Dodge men and capital.

GREAT BEND, KAN.—A telephone line will be constructed between this place and Hutchinson along the Sante Fe road. Exchanges will be established in different towns through which the line passes.

PRAIRIE DU CHIEN, WIS.—The Crawford & Grant County Telephone Companies are extending their lines to Bridgeport, where they will join in a common line for communication over both systems.

WINDOM, MINN.—The Northwestern Telephone Company have closed the contracts for the material for the extension of their telephone line from Lake Crystal to Sioux Falls, which will pass through Windom.

THE ERIE TELEGRAPH & TELEPHONE COMPANY made a net gain of 312 subscribers in April, making the gain for the first four months of the fiscal year of 1005. The total number connected May 1 was 19,396.

CINCINNATI, O.—The telephone rates are to be reduced within the Cincinnati exchange district. The new rates are much lower than those charged in other cities for similar service. The new rates are for metallic service.

SOUTH BEND, IND.—Ground has been broken on Michigan Street for the South Bend Telephone Company's conduit, in which the company's wires will be laid inside the fire limits. The conduits are laid at a depth of three feet.

CLEVELAND, O.—Henry George, Jr., representing the Home Telephone Company, has filed a certified check for $5000 with the City Treasurer, and made application for a permit to erect telephone poles in the eastern part of the city.

HAZLEHURST, MISS.—The Mississippi Telephone Company is now manufacturing a new style exchange switchboard in which no annunciator drops are used, thereby getting around a great annoyance, and giving quicker and better service to subscribers.

CHICAGO, ILL.—The annual meeting of the stockholders of the Harrison International Telephone Company was held a few days ago, and directors and officers were elected. L. E. Ingalls was elected president, H. S. Smith vice-president, S. T. Kimball secretary.

TOLEDO, O.—The City Council is considering a proposed ordinance ordering every overhead wire in the business district to be taken down and put underground. It is not thought there will be much opposition on the part of the telegraph and telephone companies.

TAUNTON, MASS.—The Southern Massachusetts Telephone Company has sent a petition to the City Council asking for the right to construct conduits on Weir, Main and Cohannet streets and Broadway, in which to place telephone wires. The petition will probably be granted.

ROCK VALLEY, IA.—The Iowa Telephone Company has purchased the line of the Sioux County Telephone Company, which latter line has connections in about all the towns in this county. The new management will make extensive improvements and afford better accommodations.

SAN FRANCISCO.—A special Commission has arrived here, authorized by the Japanese Government, to study the workings of electrical power and telephone systems in the United States. The Commission is composed of S. Mine, R. Natayama, and Y. Wadachi. They will be about two weeks on this coast and then go East.

MANCHESTER, IA.—It is reported that the new telephone system between here and Marion will be in operation in about two months. All intermediate points and some localities distant several miles from the main line will form part of the exchange. Another feature of the work will be a telephone exchange in Marion with a wire to Cedar Rapids.

BALTIMORE, MD.—A suit is pending in the United States Court at Baltimore, brought by Augustus G. Davis against the Chesapeake & Potomac Telephone Company. The suit was instituted for the purpose of restraining the telephone company from using certain electrical pins which are used in telephones, the patent for which is owned by Mr. Davis.

FENTON, MICH.—A committee of Fenton citizens interested in the organization of a telephone company here went to Holly to ascertain the conditions of the mutual telephone plan. The people of Holly expect to put in a mutual exchange and they are willing to construct the line half way to Fenton if it will be completed by the exchange of this place, thus connecting the two towns.

FORT DODGE, IA.—Mr. Hazen, organizer of the Home Telephone Company, of Sioux City, visited this city for the purpose of interesting the business men in the formation of a new telephone company. In order to establish an exchange in Fort Dodge it will be necessary to secure 60 subscribers who must pay $65 each. Mr. Hazen is meeting with good success and expects to secure the desired number.

INDIANAPOLIS, IND.—A suit has been filed in the United States Court here by the Western Electric Company, against Peter C. Burns, for alleged infringement of certain telephone apparatus. It is claimed that Burns is infringing the patent in Kokomo, Ind., by using the device in a telephone exchange, and that he is about to enter into the manufacture of the apparatus on a large scale. An injunction and accounting are asked for by the plaintiffs.

THE FERNANDINA LIGHT & CREOSOTE WORKS have just furnished the Southern Bell Telephone Company for their telephone exchange at Savannah, Ga., some long creosoted yellow pine poles for the distribution of the cable. The poles are 75, 80 and 85 feet long, 10 inches in diameter at the top, and average 20 inches in diameter at the butt. They are straight and smooth. The poles were finished at the works of the company before being shipped.

A TERROR BY TELEPHONE.—The editor of the Nevada, Ia., paper will get after his delinquent subscribers, and this is the way he will do it: "The telephone line is now an assured thing, and we are rejoicing to think that we will soon be able to call those fellows up down South and tell them just what we think of them. Our bashful disposition never allows us to talk to a man's face as we would like to, but when we get at the telephone we are a terror."

ELECTRIC LIGHT AND POWER.

MARTINEZ, CAL.—The Board of Trade is investigating the cost of putting in an electric plant.

MIDDLETOWN, CONN.—The draw of the new Portland-Middletown bridge is now operated by electric power.

GRINNELL, ILL.—The Hon. Joel Stewart is chairman of committee to investigate the cost of a municipal lighting plant.

HAMMONTON, N. J.—The question of introducing an electric light plant in this town is being considered by the Council.

HARRIMAN, TENN.—H. W. Veazy & Sons, of this place, have secured the contract to build an electric light plant at Eufaula, Ala.

ALAMEDA, CAL.—Stanley Stephenson, J. B. Nashburg and others are interested in the establishment of a new lighting plant.

KIRKWOOD, MO.—The Surburban Electric Light & Power Company has the contract to light the streets of the town for five years.

PORTLAND, MICH.—The Village Council will receive proposals up to July 7 for the purchase of $15,000 of electric light bonds. W. W. Bogue, clerk.

ELGIN, ILL.—A franchise has been granted to the Merchants' Co-operative Company for the construction and operation of an electric light plant in this city.

WOODVILLE, O.—At a special election it was voted to bond the town for $10,000 to put in electric lights. The contract will be let as soon as arrangements can be made.

LOCKPORT. N. Y.—Mayor Peterson has returned to Gov. Morton, without his approval, the bill authorizing Lockport to bond itself for $40,000 for an electric light plant.

BAY VIEW, MICH.—The contract for the electric lighting plant for the Bay View Camp Ground Association has been awarded to the Furniture City Electric Company, Grand Rapids, Mich.

SALT LAKE CITY, UTAH.—The City Council has accepted the bid of the Big Cottonwood Power Company to furnish the city with electric lighting for a period of two years at the rate of $8.50 per lamp.

DOVER, N. J.—Sealed proposals are invited for the purchase of bonds of the Dover Electric Light Company. The proceeds will be used in erecting a new electric light plant, and extending the present system.

PORTLAND, MICH.—The Hon. R. W. Alton, president of the Village Council will receive proposals for the electric plant, July 7, 1896. H. H. Humphrey is engineer. Specifications will be furnished after June 25.

DES MOINES, IA.—During the recent storm in this section an electric light tower, 150 feet high, was blown down in Council Bluffs. Several hundred electric wires were carried down with it. It cost $1000 to erect.

UTICA, N. Y.—Bids have been invited for furnishing a system of electric lighting at the Central Depot in this city, which shall consist of 4500 candle-power in incandescent lights, and 10,000 candle-power in arc lights.

DEXTER, MICH.—The Village Council voted in favor of putting in a system of electric lighting for the village. Whether bonds will be issued for the purchase of a plant, or a stock company formed, has not yet been decided.

MOHAWK, N. Y.—An electric light plant for this town is one of the early possibilities. The Board of Water and Light Commissioners have visited several places in this vicinity to investigate and examine the various electric light plants.

McKEESPORT, PA.—The City Comptroller has been authorized to advertise for bids for the proposed electric light plant. Bids will be received on dynamos for 200 arc lights, an incandescent machine for not less than 500 lamps capacity, one 300-hp engine and two boilers of 150 horse-power each.

OTTAWA BEACH, MICH.—The C. & W. M. Railway Company has given to the Furniture City Electric Company, of Grand Rapids, Mich., the contract for a complete Edison lighting plant for the new hotel and other buildings in this place. Arc lights will be used to illuminate the grounds.

BATH, N. Y.—The Bath Electric Illuminating & Power Company has submitted a proposition to the trustees of the village of Hammondsport for lighting the streets. The offer is to furnish 75 lights of 20 candle-power, burning 240 nights in the year, from dusk until 11 p. m., for the sum of $900.

LOCKPORT, N. Y.—Action on the municipal electric lighting plant has been postponed for the time being on account of the possibility of obtaining electric power from Niagara Falls. It is thought that the transmitted power may be secured at a rate which might justify its importation for lighting the city.

HARTFORD, CONN.—The affairs of the Schuyler Electric Company have been wound up by order of the court, and Receiver Lewis Sperry's duties are ended. A balance of $71,780 has been divided among the preferred stockholders, of which the General Electric Company, of Schenectady, N. Y., receives $68,729.

BRIDGEPORT, CONN.—An order of sale and permission to wind up the affairs of the Norwalk & South Norwalk Electric Light Company was granted by Judge F. G. Hall in the Supreme Court in this city on May 8. The motion was made by the attorney for the dissatisfied stockholders. An auction sale will be held on June 16.

BLACK RIVER FALLS, WIS.—Aldermen Crosby, Ormsby and Homstad were appointed a committee on electric lights, with instructions to ascertain what it would cost to procure a new electric light plant, how much the present can be procured for and on what terms the lighting contract which expires July 1 can be renewed.

MIDDLETOWN, N. Y.—The electric light plant of this city has been turned over to Mr. C. S. Hamner, representative of the Peoples Electric Light Company, which has purchased the property. This company owns and controls plants in several of the most important cities in New Jersey, and has its headquarters at Newark. It is the purpose of the company to remodel the plant and install the most modern machinery.

HARTFORD, CONN.—On May 6 Judge Shipman in the United States Circuit Court issued a decree of injunction against the Perkins Electric Switch Company of this city in the suit brought by the Edison Electric Light Company. Nominal damages were awarded. The Edison Company sued the Perkins Company to recover damages for alleged infringement of a patented socket for incandescent lamps.—Patent No. 257,277.

BIDS FOR ELECTRIC LIGHT PLANT.—Bids will be received by the Board of Public Works of the City of Indianapolis, Ind., for the complete installation of an electric light plant in Tomlinson Hall, including engines, dynamos and wiring. Plans and specifications are on file at the office of the Indianapolis Electric Company, electric engineers, 28 and 30 East Georgia Street. Bids will be received until 9 a.m., Monday, May 25. City reserves the right to reject any and all bids.

BERKLEY, VA.—The following is the scale of prices that has been adopted by the Berkley Electric Light Company: City arc lights, $7.50 per month; commercial arc lights, all night, $12 a month; commercial arc lights, 12 o'clock, $8 a month. Commercial—Schedule of rates, 16-candle-power: One light, $1 each; two lights, $1 each; three lights, 90 cents each; four lights, 85 cents each; five lights, 80 cents each; over 10 lights, 75 cents each; residence, 75 cents each; residence, over 10 lights, 50 cents each.

WASHINGTON, D. C.—Senator Harris was directed to report favorably a a bill to authorize the extension of the lines of the Potomac Electric & Power Company. The company is authorized to extend its lines and to operate them for light, heat and power purposes. No overhead wires are to be erected in the city, and all such now in existence shall be placed in conduits within six months. Outside of the city, and in the fire limits, the Commissioners may grant permits for the construction of overhead and underground lines.

BRAINTREE, MASS.—A committee has been appointed to investigate the electric light department. An expert accountant was engaged to go over the books. In his report he will show that the cost per year of arc lights was $68, and the cost per hour for house lights was 7.3 mills. The town has been charging users 6 mills for house lights, which represents a loss of about 2 per cent., while on the other hand, the town gains about 42 per cent. on the arc lights. The expert will recommend that improved machinery should be installed in the plant. The committee will also recommend that the accounts be kept in a more methodical manner. Braintree is the second place in the State to adopt municipal lighting.

THE ELECTRIC RAILWAY.

CARLISLE, PA.—The Carlisle trolley line will be extended to Boiling Springs.

ELWOOD, IND.—The Street Railway Company will extend its line to the fair grounds.

WILMINGTON, DEL.—The route of the Wilmington & New Castle Electric Railway is being surveyed.

WATERLOO, N. Y.—A project is on foot for the construction of an electric railway from Waterloo to Sodus *via* Lyons.

OGDEN, UTAH.—A franchise has been granted to the Power Dam Company to build a single track railway along Twelfth Street.

READING, PA.—The Neversink Mountain Railway Company will build a branch of their line to the Glen Hotel, at Klapperthal, a distance of a mile.

BROOKLYN, N. Y.—The receipts of the Brooklyn Heights Railway Company for the first week in May show an increase of $3,093 over the same period last year.

SCRANTON, PA.—The Scranton & Pittston Traction Company has decided to erect a large power house at Avoca. Work will be commenced in a week or so.

PITTSBURG, PA.—The Fort Pitt traction line was opened on May 9, and a party of Pittsburg's representative citizens made a special trip over the line, a banquet being served on their return.

ALBANY, N. Y.—Authority has been granted by the State Railroad Commissioners to the Mountain Lake Electric Railway Company to construct a road from Gloversville to Mountain Lake.

NORFOLK, VA.—The Petersburg Electric Railway Company held a meeting and a reorganization was effected. The company proposes at an early date to improve its service and extend its lines.

LOCKPORT, N. Y.—An electric road is to be built to Olcott this Summer. The line after reaching Olcott will be extended next Summer to Wilson, and will be eventually connected with Youngstown.

OCONOMOWOC, WIS.—There is talk of extending the Milwaukee & Waukesha Electric Railway to this place. Representatives of the company were here a few days ago looking over the ground.

BUFFALO, N. Y.—Forty-two street railway men went to Milwaukee a few nights ago to take the places of striking street car men in that city. They lost their places in Buffalo through the late strike.

BROOKLYN, N. Y.—The Nassau Electric Railway Company states that it has discharged over 60 men for reckless running of its cars, and that it is now doing everything in its power to correct the evil.

LOS ANGELES, CAL.—It is reported that the General Electric Company has brought suit against the Pasadena & Mt. Wilson Railway Company to recover $3000 alleged to be due upon two notes of $1500 each.

LONG ISLAND CITY, N. Y.—The Long Island City & Newtown Electric Railway was sold at auction in this place on May 9, the price paid being $700,000. It was bought in for the Steinway Electric Railway Company.

DULUTH, MINN.—The street railway company will begin in a short time to lay the track to connect the West Superior Street line of track on West Third Street, which was laid last Fall by P. R. McDonnell, for the company.

BALTIMORE, MD.—It is stated that the Baltimore & Ohio Railroad Company has accepted the electric locomotives and plant built by the General Electric Company for the propulsion of trains through the company's tunnels.

ELYRIA, O.—The Lorain County Commissioners have granted a franchise for the building of an electric road from the Ashland County line to Wellington, O. This will be a continuation of the Mansfield & Ashland line.

CITY OF MEXICO, MEX.—The entire street railway system of this city and suburbs has been sold to a London and South African syndicate. The new company will take possession in July and will introduce electricity on the lines.

OTTAWA, ILL.—The Baird Electrical Conduit Company, of Chicago, has asked for a franchise to build an electric road in this place. The company proposes to build four or five miles of road as soon as arrangements can be made therefor.

HAZELTON, PA.—The directors of the West End Electric Power Company held a meeting when plans and specifications were accepted for the new plant. Bids for the construction of the plant have been advertised for, and all bids are to be in by May 25.

WILLIAMSPORT, PA.—The Mayor and Town Council of Williamsport met in special session, and passed an ordinance granting the Hagerstown Street railway the right of way over any of the streets within the corporation limits, over which they may wish to run their cars.

GREENBUSH, (P. O. ALBANY), N. Y.—A project is on foot to build an electric railway from Greenbush to Nassau, passing through East Greenbush, and ending at the foot of Second Avenue, where connection will be made with the Smith & Taylor line of boats for Albany.

PEEKSKILL, N. Y.—A scheme is now on foot to organize the Peekskill Electric Railway Company, with a capital of $100,000. The object of the proposed company is to apply to the Peekskill Board of Trustees for a franchise to construct and maintain a surface road in that village.

PHILADELPHIA, PA —The Christian and Ellsworth Streets and Richmond lines of the former Philadelphia Traction system have been consolidated and were operated by electricity for the first time on May 6. The Callowhill Street line is the only one in the city that is now operated by horses.

OSHKOSH, WIS.—The Central Wisconsin Electric Railway Company has been declared insolvent, and F. H. Josslyn has been named as receiver under bonds of $12,000. This action is the result of an unsatisfied judgment. The nominal bonds are said to be $20,000 and the liabilities $22,000.

BROOKLYN, N. Y —The three-cent extra fare bill on the Brooklyn, Queens County & Suburban road's trolley line, in Metropolitan Avenue, from Lutheran Cemetery to St John's Cemetery, has been abolished, and the whole ride from the Broadway Ferry to the cemeteries costs now only five cents.

GREECE, N. Y.—The residents of Greece who are interested in the proposed new street car line on the West Side Boulevard, met for the purpose of perfecting an organization to further that object. A committee consisting of Herman Glass, J. A. Bernhard and Arsen Mymon was appointed.

NEW HAVEN, CONN —Definite plans have been made for a new trolley road from the large factory borrough of Torrington through Litchfield to Bantam Lake, a distance of about eight miles. The scheme is bitterly opposed by residents of Litchfield, as it will injure that place as a Summer resort.

NILES, MICH.—An electric railway will be built soon from South Bend to Benton Harbor, running through Niles, Buchanan and Berrien Springs. The power will come from three dams, one at Bertrand, one at Buchanan, and the other at Berrien Springs. F. E. Lee, the Dowagiac capitalist, is at the head of the movement

PITTSBURG, PA.—The directors of the Butler & Pittsburg Railroad will elect officials for the road and discuss a proposition to operate a line between Braddock and the Allegheny River by electricity. Superintendent W. H. House, of the maintenance of way department of the Pittsburg & Lake Erie Railroad, may be chosen chief engineer.

BROOKLYN, N.Y.—Thomas J. Brown, of this city, was arraigned in court on a charge of having endangered the health of Albert B. Hussey by keeping a noisy rooster in his yard. The case was in progress for a couple of days, when it was suddenly brought to a close by the announcement that the rooster had been run over by a trolley car and his head cut off.

BROOKLYN, N. Y.—Justice Osborne of the Supreme Court has granted a writ of mandamus directing City Works Commissioner Willis to issue permission for the building by the Nassau Electric Railway on behalf of the Atlantic Avenue Railway Company, of a double-track street surface railway on Buffalo Avenue between Bergen and Douglas Streets.

NEW YORK, N. Y.—The Third Avenue Railway Company has purchased 100 lots in the upper part of Kingsbridge road, a part of which it is understood is to be used as a site for the new power house in connection with the electric surface road, the franchise for which the company holds. Officers of the company will not say what they intend to do with the lots.

NEW HAVEN, CONN.—The case of the Winchester Avenue line against the City of New Haven, involving the city's right to tax the company $700 a mile on all its lines as a condition of extension, has been sent by the consent of both parties to the Supreme Court of the State. It is a test case in municipal taxation of trolley roads now taxed in Connecticut only by the State.

OTTAWA, ILL —The Ottawa Electric Street Railway Company, which suspended operation recently owing to the failure of the road to pay expenses, now has two prospective buyers, the Electric Conduit Railway Company, of which Mr. F. C. Baird is the representative, and J. McMillan Smith, the principal owner of the South Bend & Mishawaka Street Railway Company. Both of these gentlemen have examined the road and seem anxious to purchase it if satisfactory arrangements can be made.

CLEVELAND, O.—The directors of the Cleveland, Wadsworth & Southern Electric Railway Company have decided to increase the capital stock of the company from $10,000 to $100,000, in order to facilitate the building of the road. The route of the proposed road is through Sharon, South Road, Grangerberg, Remoen's Corners, Hinckley and Royalton, and it is also intended to run a line east to Barberton. Another contemplated branch will extend to Akron. G. D. Hile and James L. Maudlin are interested.

LONG ISLAND CITY, N. Y —The walls of the new power house for the electric light plant have been finished, and the brick work will be completed in a few days. Two engine beds have been laid, one for a 600 and the other for an 800-hp engine, and the engines are being put in place. The plant will have a capacity of maintaining 1400 arc lights, and a vertical triple expansion engine will be installed, capable of maintaining 5000 incandescent lights. The plant will probably be in operation shortly after June 1.

BRISTOL, PA.—Work was started last week on the power-house and car barn for the new Bristol turnpike trolley road, to be built from Poquessing Creek to Bristol, a distance of seven miles. The buildings are being constructed on a tract of land just west of Croydon station on the Pennsylvania Railroad, with a frontage on Neshaminy Creek. The new line will connect at Poquessing Creek with the Holmesburg, Tacony & Frankford trolley road, and when finished will form a continuous road from Bristol to Philadelphia.

MILWAUKEE, WIS.—The strike of employees of the Milwaukee Electric Railway & Light Company is still on. It is stated that almost every employee has quit and the workmen seem to be pretty well organized. The company is advertising for motormen and conductors. The company claims to have made preparations to meet the emergency, and that it will hold out all Summer rather than concede to the demands of the men. Electrical workers in other branches of the electrical business it is reported will strike in sympathy with the railway men.

BALTIMORE, MD.—At the convention last week of the National Municipal League, a paper was read by Mr. Frank M Loomis, of Buffalo, on the subject of municipal ownership of street railways. He was opposed to the idea and said that a careful investigation of the earnings of the street railways of the larger cities of the United States showed that better service could be given to the people at much lower rates than those now prevailing. The reduction, he said, of 30 or 40 per cent. in the usual fares or the payment of a corresponding amount into the public treasuries, would still leave a liberal margin of profit on the original investments of the companies.

NEW HAVEN, CONN.—The trolley line that is being constructed between New Britain and Hartford encountered a new obstacle on the 13th inst. in a temporary injunction asked for by the New England Steam Railroad Company The injunction applies to the three trolley companies, the Hartford Street Railway Company, the General Electric Company of New Britain and the Newington Tramway Company, which are interested in the parallel line. The New England's counsel, in his application, contends that the new parallel plan under a change of form violates the ruling of Judge Hall last Spring against the trolley line between the two cities.

BALTIMORE TRACTION COMPANY.—At the monthly meeting of the directors of the Baltimore Traction Company on May 14 the agreement between the company and the South Shore Electric Railway Company was ratified. Under this agreement the Baltimore Traction Company assumes the perpetual control of the South Shore line, about two and one half miles in length, from the foot of Ridgely Street It runs along the south side of Spring Gardens. The Huntingdon Avenue cars now have their southern terminus at Ridgely Street, and the new line will become a part of the Huntingdon Avenue route, with one fare through to the terminus of the new line. The entire road will not be completed until about June 1.

EASTON, PA.—The governor of the 800-hp engine of the plant of the Edison Illuminating Company in this place broke a few days ago causing the cylinder head to blow out and other damage to the plant and building. Fortunately a spare engine was available and work was resumed with only about one hour and a half stoppage on the electric road, the accident having occurred during the daytime. The damage will require about six weeks to repair. The plant was further disabled on May 12 by the breaking down of one of the extra engines which had been in operation since the first break-down. This engine also suffered the same injury as the first, that is by the cylinder-head blowing out. The entire load of the plant is now thrown on one 400-hp engine.

Personal Notes.

E. W. RICE.—The many friends of this gentleman will be pained to learn of the recent death of his wife at Colorado Springs, Col. Mrs. Rice leaves two sons and a daughter. Her remains were buried at Lynn, Mass.

PROF. HAROLD B. SMITH, Professor of Electrical Engineering at Purdue University, Lafayette, Ind., has been elected by the trustees of the Worcester Polytechnic Institute, Worcester, Mass., to fill the new Chair of Electricity at the latter institution. He will assume his new duties about July 1.

Trade and Industrial Notes.

THE MURRAY IRON WORKS COMPANY, Burlington, Ia , has just issued a neat and well-illustrated catalogue of its boilers and engines.

ALTERNATING-CURRENT MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., has issued its 1896 catalogue of alternating-current motors for farm and power purposes.

THE FERRACUTE MACHINE COMPANY, Bridgeton, N. J , in a folder illustrates a large number of its standard power presses. Over 300 presses are described in its catalogue, No. 11, recently issued.

ERIE, PA.—The Keystone Electric Company will erect another large building and double its present capacity for the manufacture of electric motors. A new gas engine will be used for the operation of the plant.

J. ELLIOTT SHAW & CO., Philadelphia, have just issued a catalogue and price list of household and experimental electrical supplies. It is very complete, and at the back is given some valuable information and diagrams.

THE TUERK WATER METER COMPANY Fulton, N. Y., has been succeeded by the Hunter Fan & Motor Company. The new firm is composed of John Hunter and J. C. Hunter, of the old company. All obligations of the old company will be assumed by the new one.

THE STANDARD AIR BRAKE COMPANY, New York, has issued a very complete pamphlet of its air brake system. The pamphlet is elaborately illustrated, and is provided with an index to its contents. These air brakes are adapted for electric passenger, freight cars and locomotives, cable cars, rack railway cars, lifting bridges, etc.

THE STEWART MANUFACTURING COMPANY, Binghamton, N. Y., in its catalogue No. 6 just issued, gives considerable information regarding its flexible shafting for portable drilling, tapping, reaming, wood boring, emery-grinding, etc., etc. This shafting may be driven by electric motor rope transmission. The catalogue is fully illustrated.

FEED WATER HEATERS.—The Kensington Engine Works, Limited, Philadelphia, Pa., have just closed a contract with the William Cramp & Sons' Ship & Engine Building Company, for two of their large water tube heaters. They will be 38 inches in diameter by 20 feet long, and tested for a working pressure of 150 pounds. These heaters will be installed in the power plant, at Washington, D. C., for the electric trolley line between Baltimore and Washington.

THE UNITED STATES PROJECTILE COMPANY, Brooklyn, N. Y., is erecting a new building to meet the large demand for its products. The new building will be 100 feet wide and 450 feet long, of steel skeleton structure throughout. The steel work for the building has been designed and will be erected by the Berlin Iron Bridge Company, East Berlin, Conn. The trusses have a clear span of 100 feet, and the general construction is such that it will make one of the finest buildings of the kind in the country.

INJUNCTION GRANTED.—Judge Dallas, of the United States Circuit Court for the Eastern District of Pennsylvania, filed an opinion on April 6 granting the Ewart Manufacturing Company a preliminary injunction against James H. Mitchell, restraining the latter from the manufacture of an infringement of the plaintiff company's patented chain, which is known as the "Dodge Chain," and which is legally manufactured by the Link-Belt Engineering Company, of Philadelphia, and the Link-Belt Machinery Company, of Chicago.

GAUGE GLASSES.—The Allen Indicator Gauge Glass Company, Philadelphia, Pa., has issued a circular regarding its patented gauge glasses for steam boilers. These glasses are made to stand a pressure of from 500 to 1000 pounds, according to size, and are of recognized merit, having been on the market for about four years. They are rapidly coming into general favor. The indicators are made in two styles, white and blue. The white ones show at once the amount of water in the glass without the aid of artificial light in dark places, and the blue ones are used upon boilers that are located in light places.

GREEN ENGINES.—The Providence Steam Engine Company, of Providence, R. I., builder of the improved Green engine, report its shops full of work. The Green engines are especially adapted for direct-connected electric railway work, and recent contracts for this line of work cover one 500-hp and one 350-hp tandem-compound engine for the Suburban Railroad Company, Chicago; two 750-hp tandem-compound engines for the Second Avenue Traction Company, Pittsburg; two 400-hp simple engines for the street railway at New London; one 300-hp simple engine for the Hampton & Old Point Railroad, Hampton, Va.; two 700-hp for the Washington, Alexandria & Mt. Vernon road at Washington, D. C.

GRAPHITE IN ELECTRICAL INDUSTRIES.—Graphite, which is one of the forms of carbon, and more generally known as plumbago or black lead, has come to be an important factor in electrical industries. It is a graphite crucible which is used for electrical smelting, and it is a graphite pencil or rod which is used as an electrode in the process of electrical smelting. It is graphite pulverized to an impalpable powder that is used in electrolytic work by the copper smelters. Pure flake graphite is also used for lubricating cylinders and bearings of engines and dynamos, and the same material also forms the pigment for protective paints for trolley poles, electric light poles, and roofs of dynamo plants and trolley car sheds. Graphite would therefore seem to be a very important factor in electrical industries. During the last year or two the demand has very greatly increased for graphite resistance rods. Unlike German silver, it is not necessary to take into account the factor of quantity. For instance, a 6-inch rod ¼ inch in diameter may be made to have 1 ohm resistance or 10 ohms, or 1000 ohms, or in fact almost any resistance that the electrician may require. The only reason for changing the dimensions of such rod would be either convenience or for radiating the heat when it is necessary to carry a current of considerable quantity at high resistance. The Joseph Dixon Crucible Company, of Jersey City, N. J., which was the originator of the graphite industry, has paid particular attention to the requirements of electrical engineers and is supplying the electrical industries with large quantities of material.

Business Notices.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

"REFRIGERATING MACHINERY," containing the general principles of refrigerating and ice-making machinery, by George Richmond, M. E., mailed free on receipt of 20 cents in stamps. American Engineering Publishing Company, 333 Adams Street, Brooklyn, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 12, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

559,798. ELECTRIC SWITCHING APPARATUS; W. W. Dean, St. Louis, Mo. App. filed Jan. 24, 1896. The combination with an electric connecting plug provided with a core of conducting material, and a sleeve surrounding the same to form an annular space about said core, of a spring-jack switch provided with four springs, having their free ends in the same plane, said plug being adapted to be inserted in said spring-jack, the core of said plug being adapted to wedge apart the two inner springs of the spring-jack switch and form contact therewith, and the sleeve of the same plug being adapted to wedge apart the outer of said springs and form contact therewith.

559,796. ELECTRICALLY OPERATED RAILWAY SWITCH; A C. Goetz, Milwaukee, Wis. App. filed Aug. 24, 1893. An insulating section for an electric line consisting of a block of insulating material, to one edge of which the electric line is attached, and having a short wire attached to its opposite edge, said short wire insulated by the block from the main line.

559,800. AUTOMATIC TRACK SWITCH FOR ELECTRIC RAILWAYS; W. C. Henry, Milwaukee, Wis. App. filed Dec 20, 1893. In a trolley system of electric railways, a continuous-current conveyor, and two insulated sections, a certain distance apart in the path of a trolley, in combination with electromagnets jointly in circuit with the current conveyor, and severally in circuit with the insulated sections, and a switch tongue controlled by the magnets, either of the latter being energized by contact of the trolley with the relative insulated section when current is on a car carrying said trolley.

559,801. ELECTRIC LIGHT FOR BICYCLES; B. B. Hoffman, New York, N. Y. App. filed May 24, 1895. In an electric light for bicycles, the combination of a lantern case, a reflector removably secured therein, a lamp socket removably secured in said case and located entirely beneath said reflector, and a lamp carried in said socket and extending through the lower wall of said reflector whereby when the lamp is removed from the socket the reflector can be removed.

559,821. TELEGRAPHIC PRINTING APPARATUS; H. C. Spaulding, Boston, Mass. App. filed April 23, 1895. A telephone-selecting device consisting of sets of circuit branches normally open, one set superposed upon the other so as to bring the branches of one set across the branches of the other, in combination with a key having a plurality of contact-closers corresponding in location with determined intersections of the circuit branches, so arranged that by the operation of the key electrical connection between the branches of the sets may be established at any group of intersections of circuit branches.

559,837. ELECTRIC TELEPHONE TRANSMITTER; N. Bassett, Philadelphia, Pa. App. filed Nov 19, 1895. In a telephone transmitter, the combination with a diaphragm, of fixed terminal electrodes, and a movable electrode which bridges said terminal electrodes and is in electrical contact therewith and which bears or presses against the diaphragm.

559,863. ELECTRIC ARC LAMP; S. E. Nutting, Chicago, Ill. App filed Oct. 18, 1893. In constant-potential arc lamps the combination of an arc drawing magnet, a shunt-circuit around the arc, and means operated by the magnet for varying the resistance of the shunt-circuit around the arc.

559,869. SELECTIVE SIGNAL AND LOOK-OUT SYSTEM; C. E. Scribner, Chicago, Ill. App. filed May 18, 1895. In combination, two electromagnetic responsive devices adapted to respond to pulsatory currents of opposite polarity in different parallel branches of a circuit, a generator or pulsatory current in the circuit, and means for short-circuiting the responsive devices during the intermissions of current.

559,872. SYSTEM OF ELECTRICAL TRANSPORTATION; P. K. Stern, St. Louis, Mo. App. filed Sept 16, 1895. An electric transportation system, consisting of a route or line of travel, a vehicle which is adapted to travel along said route, a primary-inducing element, which is arranged along said route, and a laminated wheel, mounted on said vehicle, which wheel is influenced by the primary element. (See Illustration)

559,874. TELEPHONE SYSTEM; W. F. Taylor, Montreal, Can. App. filed Aug. 3, 1894. In a telephone system, the combination of movable keys; spring terminals, one located in the path of each key, and normally in open-circuit relation therewith; means for keeping the spring terminals in alignment, consisting of an insulating-bar located between the keys and said terminals; a telephone instrument included in a circuit between the keys and a return-conductor; and other telephone instruments included in circuits between the return-conductor and the spring terminals, each telephone being connected to a separate terminal.

559,889. ELECTRIC CLOCK; B. Franklin and D. H. Fletcher. App. filed April 11, 1893. The combination with a clock train of a pivoted lever in operative connection with the driving-arbor of the train, means for actuating said lever, a shifting device for alternately changing the direction of its movement, an armature in operative connection with said shifting device, a source of electricity and means for automatically making and breaking the electric circuit at regular intervals corresponding to the movement of said driving-lever.

559,903 STEERING GEAR FOR SHIPS; M Pfatischer, Philadelphia, Pa. App. filed Aug. 24, 1895. In combination with a ship's rudder and motive power for turning it, an electrically actuated controlling device therefor, a motor or generator armature, commutator and adjustable brushes therefor, included in circuit with said controlling device, a second such armature, commutator and adjustable brushes, also included in said circuit, and mechanical connections for automatically adjusting the last said brushes simultaneously with the said rudder.

559,904. ELECTRICAL STEERING GEAR; M. Pfatischer, Philadelphia, Pa. App. filed Dec. 26, 1895. The method of electrically controlling and adjusting from a distance of ship's rudder, gun, signal apparatus, or other adjustable mechanism, by introducing into the field into the field magnet circuit of an electrical generator, a current corresponding in direction to the deviation of the controlling handle or device, causing the current thereby generated to control and apply the motive power for adjusting the said adjustable mechanism; and causing such adjustment to introduce an opposing and equal E. M. F. or current into said balance-circuit and thereby stop the said adjustment.

559,907. RUNNING COMPOUND-WOUND GENERATORS IN MULTIPLE; W B. Potter, Schenectady, N. Y App. filed Feb. 25, 1896. The means for adjusting the compounding effect of generators operated in multiple, consisting of a shunt around the series circuit of each of said machines, the shunt being substantially equal in resistance to the resistance of the series-coil and its adjusting resistance.

559,910. ARMATURE FOR DYNAMO-ELECTRIC MACHINES; H. G. Reist, Schenectady, N. Y. App. filed Jan. 31, 1896. In combination, an armature spider having a central boss or hub, separate arms radiating therefrom, said arms being provided upon their outer ends with dovetail grooves and laminæ, having dovetail projections fitting in the groove, thus connecting the arms.

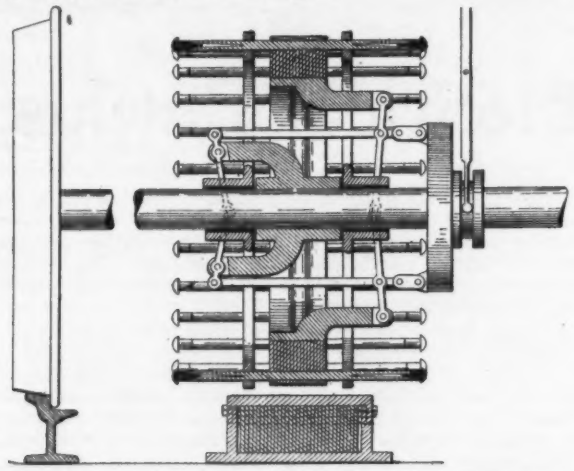
559,913. ALTERNATING-CURRENT SYSTEM OF DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App filed Feb 5, 1896. An alternating-current system of distribution, comprising transformers having their primaries connected in delta, and their secondaries in Y, and a neutral or equalizing wire extending from the common junction of the secondary only.

559,916. ELECTRIC SWITCH; P. G. Tismer, New York, N. Y. App. filed March 29, 1895. A roller-bearing lever with a body enclosing a movable portion, a spring between the two parts, a top plate in separable pieces for holding the lever in position and a push-button part comprising two branches that are secured to the said lever.

559,939. ELECTRIC CIGAR LIGHTER; W. Fisher, Chicago, Ill. App. filed Oct. 12, 1895. A combined cigar lighter and display device, comprising a casing provided in one side with a transparency, or equivalent, an incandescent lamp arranged behind said transparency connected with a normally open circuit, a pair of adjacent terminals and a lighting-torch adapted to close the circuit through the lamp when inserted between said terminals.

559,988. TELEPHONE; T. Berdell, New York, N. Y. App. filed March 8, 1895. In a telephone, a diaphragm mounted in a magnetic field in a position of magnetic equipoise or stable equilibrium. (See Illustration.)

559,989. TELEPHONE; T. Berdell, New York, N. Y. App. filed June 19, 1895. In a telephone transmitter, the combination with a magnet, of two independent diaphragms loosely held in place and adjustment by magnetic force, but out of contact with the magnet.



No. 559,872.—System of Electrical Transportation.

560,006. DYNAMO-ELECTRIC MACHINE OR ELECTRIC MOTOR; O. Patin and L. Levasseur, Paris, France. App. filed June 19, 1893. In a dynamo, the combination of a fixed magnet, coils mounted on said magnet, a revoluble armature comprising coils, and a metallic disc, insulated rings, arranged side by side around a sleeve of the armature, connections between the armature coils and said rings, and a segmental commutator and connections between the latter and the rings.

560,023. THERMOSTAT; W. G. Day, Baltimore, Md. App. filed Jan. 4, 1895. A thermostat comprising a spring in an electric circuit, and a retaining device of hard rubber or the like, which is softened by abnormal heat in the surrounding air, the strength of the spring being such as to be restrained in an inoperative condition when the device is hard and to force itself into an operative condition when the device is softened.

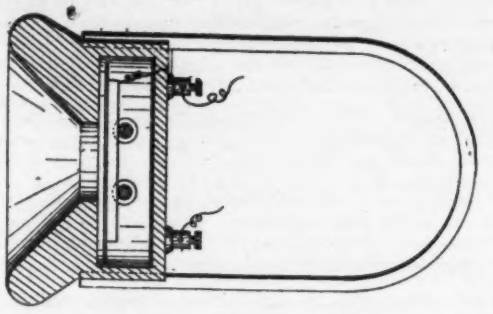
560,031. ELECTRIC RAILWAY; J. H. Guest, Boston, Mass. App. filed Dec. 3, 1895. The combination with a series of actuating coils arranged in a circle, and a core or armature progressively moved step by step through the successive actions of said coils, of a switch or circuit-changer between the coils and their working circuits, whereby the order of connection of the latter with the cores may be reversed.

560,035. ELECTRIC REGULATOR; R. M. Hunter, Philadelphia, Pa. App. filed May 22, 1894. In a regulator for electric motors, the combination of field magnets and armature relatively movable with respect to each other, devices to move one of the parts to vary its inductive relation to the other part, and switch devices movable with the movable part, for decreasing the resistance after the armature has begun to rotate.

560,039. ECECTRIC ARC LAMP; A. O. Mackin, Anderson, Ind. App. filed Oct. 3, 1895. In an arc lamp, the combination with the upper and lower carbon holders, and with a magazine adapted to contain a number of upper carbons, of mechanism for successively and automatically feeding the carbons from the magazine into the upper holder, and for releasing at the proper times the upper and lower carbons, whereby the lower carbon is permitted to fall away from the lamp, and the partially burned upper carbon is caused to drop into the lower holder, together with means whereby said partially burned upper carbon is caught in the lower holder and becomes the lower carbon.

560,043. DOOR HANDLE WITH ELECTRIC ALARM; A. J. Moulart, Paris, France. App. filed July 1, 1895. The combination with a lock case and locking bolt having a slot in it; an insulated binding post on the casing having a contact piece lying in the slot of the bolt and adapted to contact therewith when the bolt is retracted, an uninsulated binding-post on the casing; wires connecting the respective binding posts with an electric supply, and a bell interposed in the circuit, all arranged so that an alarm is sounded when the bolt is retracted.

560,071. RAILWAY SIGNAL; D. C. Stewart, Warren, O. App. filed March 9, 1894. A circuit closer, comprising a box, a pivoted spring-held arm provided with a beveled shoulder, and having a circuit wire connected thereto, a depressible bar in juxtaposition to one of the rails of a track, and designed to engage said beveled shoulder, and a contact arm to which the other circuit-wire is connected.



No. 559,988.—Telephone.

560,087. METER FOR ALTERNATING ELECTRIC CURRENTS; T. Duncan, Fort Wayne, Ind. App. filed Dec. 21, 1891. In an alternating-current meter, and in combination a coil or coils traversed by the current to be measured, a revolving secondary cutting the field or fields of force generated by such coil or coils in its revolution, a magnetic path diverter, a retarding device, and a registering train.

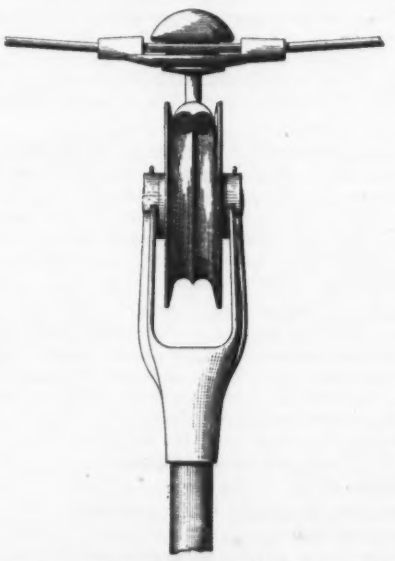
560,096. ELECTRIC CALL BELL; F. C. Jordan, Wadsworth, O. App. filed March 29, 1836. The combination with a battery and electric bell, and a clock having its hour clock in connection with one pole of the battery, of an annular rim to sustain detachable contact-fingers, and detachable contact fingers adapted to rest on said rim and make connection with said hour-hand and the opposite pole of the battery.

560,097. TROLLEY WIRE AND TROLLEY THEREFOR; H. R. Keithley, Buffalo, N. Y. App. filed Aug. 24, 1895. The combination of a trolley-wire having two ribs and two grooves, and means for supporting said trolley-wire, so that a trolley wheel may engage both of said ribs and a groove between them. (See Illustration.)

560,098. TROLLEY-WIRE AND TROLLEY THEREFOR; H. R. Keithley, New York, N. Y. App. filed March 28, 1896. As an article of manufacture, a trolley-wire having three ribs, the sides of one or more of said ribs diverging outwardly.

560,102. AUTOMATIC RAILWAY SIGNAL SYSTEM; J. W. Lattig, South Bethlehem, Pa. App. filed April 10, 1896. In automatic railway signal systems, the combination with a track-circuit and track relay therein, and a signal circuit completed through a set of contacts controlled by the track relay, of a second or auxiliary relay included also in the track circuit, and parallel with the main track-relay, and a second set of contacts included in said signal circuit and controlled by said auxiliary relay.

560,128. FUSE CUT-OUT; W. E. Harrington, Philadelphia, Pa. App. filed June 1, 1894. In a fuse cut-out for electric circuits, the combination with a terminal, a fuse wire leading therefrom, a non-conducting fluid through which a portion of the fuse wire passes, and a cover or hood to prevent the particles of melted fuse from falling up the terminal and establishing an arc.



No. 560,097.—Trolley Wire and Trolley Therefor.

560,168. ELECTRIC LAMP SOCKET; H. W. Leonard, New York, N. Y. App. filed June 28, 1890. A lamp socket comprising essentially two insulated conductors permanently embedded in a "single" piece of non-conducting mouldable or castable material, the exterior ends of the conductors being located beneath an over-hanging ledge forming part of the socket.